ARCHITECTVRAL DRAWING

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ARCHITECTURAL DRAWING

FOR

SECONDARY SCHOOLS

BY

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PREFACE

The aim of this text is twofold: first, to give to the student a practical conception of architectural construction and methods of drawing, and, second, to create in him a desire to build a home of his own that will combine beauty with utility.

It is elementary in character, but must be preceded by a short course in mechanical drawing—one or two years. In the average high school it should comprise the last two years of the drafting course; but, since some plates may be omitted, it can be combined into a one year's course.

In the authors' opinion, a course in architectural drawing will be of greater value to all students than a course in machine drawing, since every man—no matter what his vocation may be—will some day be greatly benefited by a knowledge of building design and construction.

Many thanks are extended to those persons who have helped in the preparation of this book, especially to those whose catalogues have furnished very practical material; to the Architectural Club of the University of Illinois for the use of Figures 57, 58, 59, 60 and 61; to the Hydraulic-Press Brick Co. for the use of Figures 4, 52, 54, and 55; to the Morgan Door Co. for the use of Figures 25 and 26; to the Beaver Board Co. for the use of Figure 28; and to Hunt, Helm, Ferris and Co. for the many valuable tables contributed to Chapter XVII and to the Gordon-Van Tine Co. for the illustrations of Chapter XVIII.

It is offered to the public with the sincere wish that it may prove of as great help to the American school student, as it has been a source of interest to the authors.

RALPH F. WINDOES
HARVEY B. CAMPBELL

ARCHITECTURAL DRAWING FOR SECONDARY SCHOOLS

CHAPTER I

SUGGESTIONS ON EQUIPMENT AND METHODS OF TEACHING

Although architectural drawing as a subject for high and technical schools can be taught with the regular mechanical drawing room equipment, it is very apparent to most teachers that some special equipment is desirable. To make the work *real*, and *vital* to the average student, he must be *shown*, as his *visual* memory is better than his *word* memory. For example, the various sections of a window frame may mean almost nothing to him, as they are ordinarily presented in detail drawings; but, if a frame can be *shown* to him, and the cutting planes for the various sections on the drawing pointed out, he can readily comprehend it. Figure 1 shows such a frame, cut down to convenient size, but built up of full size stock and illustrating all the principal parts.

In like manner a frame built up of half or quarter size stock might be constructed. This would show the essentials of construction, and would be easier to handle about the class. A doorframe built up in the same way would be very useful and certainly well worth building. If classes in carpentry are run in correlation with the architectural drawing, such models might be constructed by the students as carpentry projects.

In discussing frame construction at the sill line, a model such as illustrated in Figure 2 will prove invaluable. It is built up of half size stock, and on it can be pointed out the following essentials of building construction: sill, floor joists, studding, bridging, rough floor, finish floor, straight sheathing, diagonal sheathing, building paper, siding, plates, water table, drip cap, corner board, ground strips, metal lath, scratch coat of plaster, finish coat, wall board, baseboard, carpet strip, and wall board panel strips. The ingenious teacher could build his model so as to include a number of other essentials. He could also construct a model of an upper section, in a similar manner, showing the different parts at the cornice or a larger model showing a complete section of a wall—foundation, sill, window sections, and cornice section. The difference between a box and an open cornice could be made clear in a similar manner.

Roof pitches, and the various kinds of roofs can be demonstrated more clearly with the help of material things than by means of the printed page alone.*

A collection of pieces of full size mouldings, properly labeled

*See "Problems in Carpentry," by L. M. Roehl for suggestions.

with their official numbers, would be very desirable when planning interior trim. Lumber dealers are always glad to supply the teacher with a suitable collection, and no drawing room should be without them.

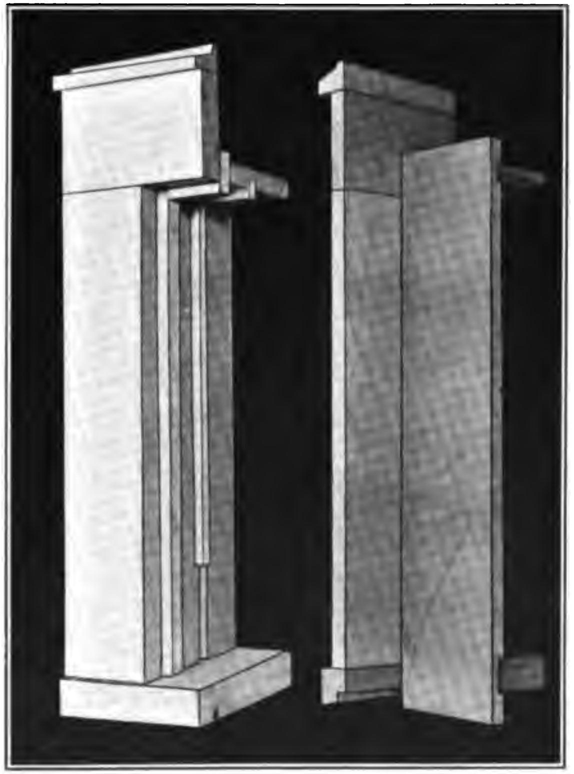


FIGURE 1.

Figure 3 is from a photograph of model Lane joist and timber hangers, which clearly illustrate this method of construction.

This example will undoubtedly suggest many other interesting exhibits that should be provided for architectural drawing classes. The atmosphere of a drawing room so equipped is so much more practical and suggestive than the one that relies entirely upon the printed page, that the progressive teacher will see its advantages at once.

Manufacturers of the various products used in architectural construction are always glad to co-operate with the school where architectural drawing is taught, and the many samples, booklets, catalogues, blue prints, etc., that they will furnish free of all cost is very evident of their interest in the education of the prospective home builder. Many valuable suggestions can be gleaned from their pages, and it is strongly advised that the teacher provide his students with a reference library of them.

If discussing bonds and brickwork, sections of walls such as are represented in Figure 4 would lend that air of reality so necessary to the clear understanding of such a subject. In like manner, small sections built up of hollow tile, concrete, stone, concrete blocks, etc., would serve to dispel most questions that might arise in the student's mind concerning these materials of construction.

Drawing rooms in most schools are so very crowded that large models such as suggested would be impossible, hence smaller scale sections could be used instead. Bricks might be represented by wooden blocks about 1″ x 2″ x 4″, painted red. These could be fastened between thin strips of wood to represent the bond or they might be left loose and the various methods of laying brick demonstrated with them. A monolithic foundation could be poured with a thin, rich, cement mixture, and made to a small scale to permit of ease in handling.

In Figure 5 we have represented a small number of metal lath samples, which will prove interesting while studying wall coverings. They may be used as test samples, if the teacher

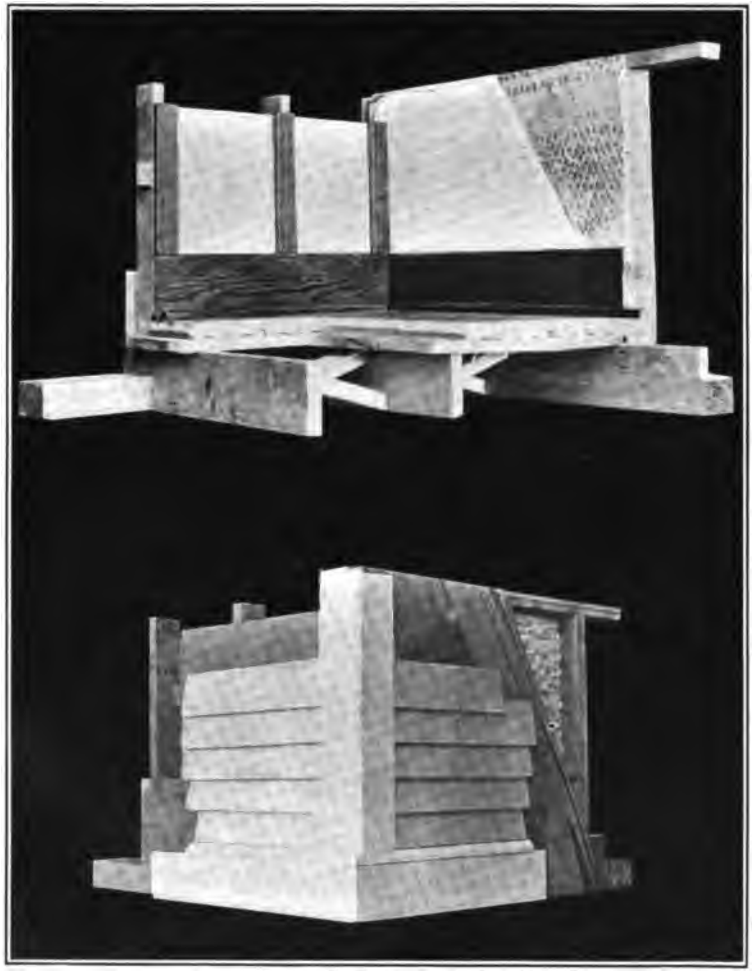


FIGURE 2

so desires. For instance, a number of different brands of the same gauge can be soaked in water containing a very little nitric acid, and the results noted as far as their rusting properties are concerned; or, they could all be covered with a thin layer of plaster, and the amount of rust that shows through the plaster taken as a comparison of quality. Students take a deep interest in such demonstrations, and the tabulated results may become of practical value to them later in life.

In a similar manner wall boards could be tested, especially for their waterproof qualities. A few samples of the many brands may be obtained of the makers. Rough apparatus might be constructed whereby the samples could be tested for tensile strength, compression, etc.

As regards methods of teaching architectural drawing, there are almost as many methods as there are teachers. Some dwell almost entirely upon the historical side of the subject. Others are strictly in the modern building class, while still others spend the entire time drawing details of old and obsolete methods of framing and construction. Some take a great deal of time for lecturing—others none at all.

After carefully considering the methods of each, and consulting a number of architects and other teachers upon the subject, the authors are inclined to side with the teacher of modern methods of construction, especially as they apply in residence work.

Boys studying architectural drawing in high and technical schools can be divided into three groups: first, those who intend to go on to college to study architecture as a profession; second, those who intend to go into an architect's office to practice architectural drafting; and, third, those who expect sometime to build and own a home of their own—this latter group by far the largest.

The historial aspect, barring a study of the orders, perhaps, has no practical value to either group excepting the first, and

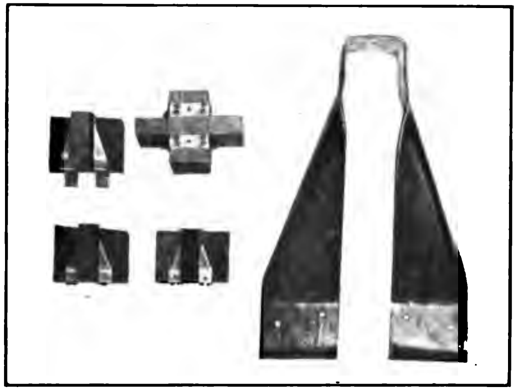


FIGURE 3.

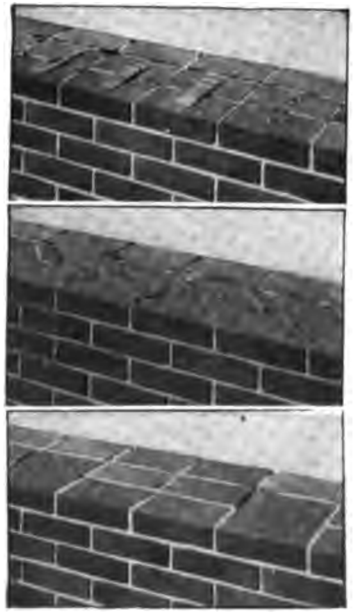


FIGURE 4.

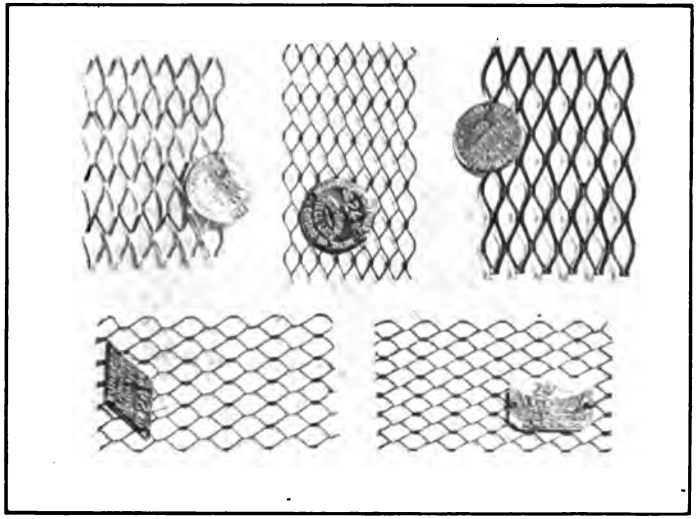


FIGURE 5.

this will be well taken care of when the boys reach college. The study of obsolete methods has no value to either group excepting as it gives them practice in the use of the instruments —which they do not need at this stage in their experience— and an insight into the methods of building a number of years ago. Hence a careful study of modern architecture in residence construction will prove of greater value to the larger number.

As each subject is introduced the teacher should accompany same by a short lecture upon that particular theme, the main points of which should be carefully transferred to the student's notebook. Quizzes and occasional written lessons should be made a part of the work, as architecture is a study as well as a laboratory subject.

REFERENCES

L. M. Roehl—"Problems in Carpentry."
"Standard Moulding Book," Compiled by N. L. Godfrey for the Sash, Door, Blind and Moulding Manufacturers of the Northwest.

CHAPTER II

ARCHITECTURAL LETTERING

The study of architectural drafting—in fact, any branch of the drafting profession—should begin with lettering. Architectural lettering, which alone will concern us, may be divided into two classes: viz., the mechanical type—Classic Renaissance or Old Roman, usually, and the free-hand type.

Mechanical Lettering. The classical letter, although its study, construction, and use are interesting, has, for obvious reasons, little or no place in the course of study of the high or technical school student. It is used only upon the class of drawings that immature students should not attempt—details of libraries and other large public buildings or upon exhibition drawings, especially where the letters are to be executed in stone or bronze, and its careful and correct construction would take too much of the student's time that could be more profitably spent upon more practical work. Hence we will consider the free-hand letter alone in this chapter.

Free-Hand Lettering. All architectural lettering is vertical, and there is no fixed style common to all architects. It is very seldom that two draftsmen will be found to use exactly the same style of architectural letter, although in schools regularity is usual, as it should be, in order to obtain uniformity among the students' plates.

In Figure 6 we have detailed a style that is, on the whole, used the most often among residence draftsmen. Its construction is very simple, and it can be rapidly made when once the style is mastered. The letters, with the exception of the M and the W, are slightly narrower than they are high. The cross lines in the H, F, E, B, and S, are made above the center, and in the A, P, and R below. Very small blocks can be added when inking, although the small size letter used for notes, etc., looks better with the blocks omitted entirely.

There are three sizes of letters used, all of the same style, as illustrated in Figure 7. For titles on sheets, or the most important part of the lettering, the 3/8" letter should be used for room titles, or the next important part, the 1/4" letter; and for the notes, etc., the 1/8" letter. This is for solid caps, of course, and, if both caps and small letters are used, the height of the caps is increased a little and the body lettering made the size as specified. In spacing titles, as the student undoubtedly knows, each line should be worked each way from the center line. For example in Figure 8 we have a title the first line of which, omitting the i's, contains thirteen letters and one space. hence the edge of the seventh letter in, the R in EXTERIOR, would come on this center line. This letter would be put in first, then the other letters of EXTERIOR, working backwards. A space would be left the width of a letter, and DETAILS would be penciled. In like manner the other lines would appear—all centered on this common line.

Instructions for Drawing Plate I

Size of paper—Demy, 15" x 20".

Size of trimming edges—13" x 19".

Size of border lines—12" x 16".

Margins—2 1/2" on left-hand edge, 1/2" on other edges.

Lay out the border lines and the trimming edges according to the data given above, and lightly pencil in the guide lines for the letters as detailed in Figure 9. To do this correctly, lay off the vertical *A-B*, and on it measure down from the top border line, first 3/4", then 1/4", then 3/4", without moving the scale, of course. This measurement will indicate the top of the first line of body lettering. Set the bow dividers for 5/32" and the large dividers for 5/16", and space down line *A-B*

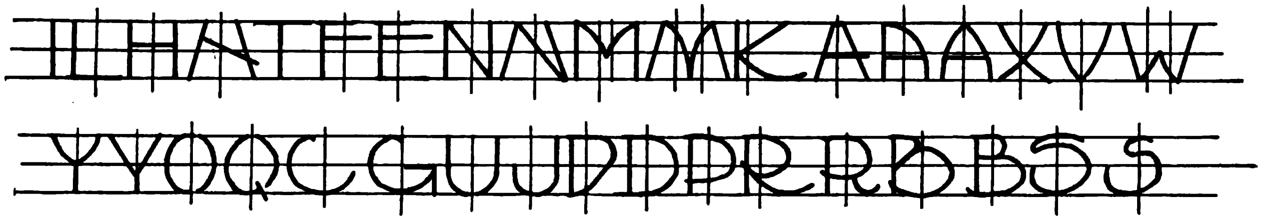


FIGURE 6.

FOR TITLES ON SHEETS

FOR ROOM TITLES

THIS SMALL LETTER IS USED FOR NOTES, SCALE, ROOM SIZES, KEY TO MATERIALS, ETC.

FIGURE 7.

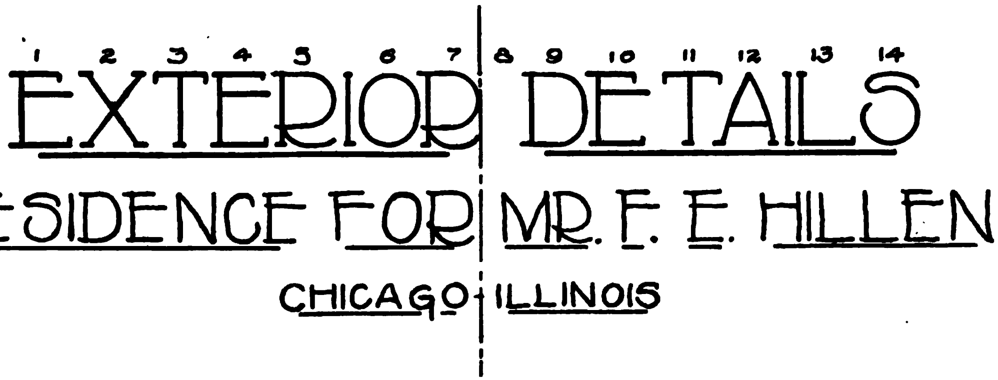


FIGURE 8.

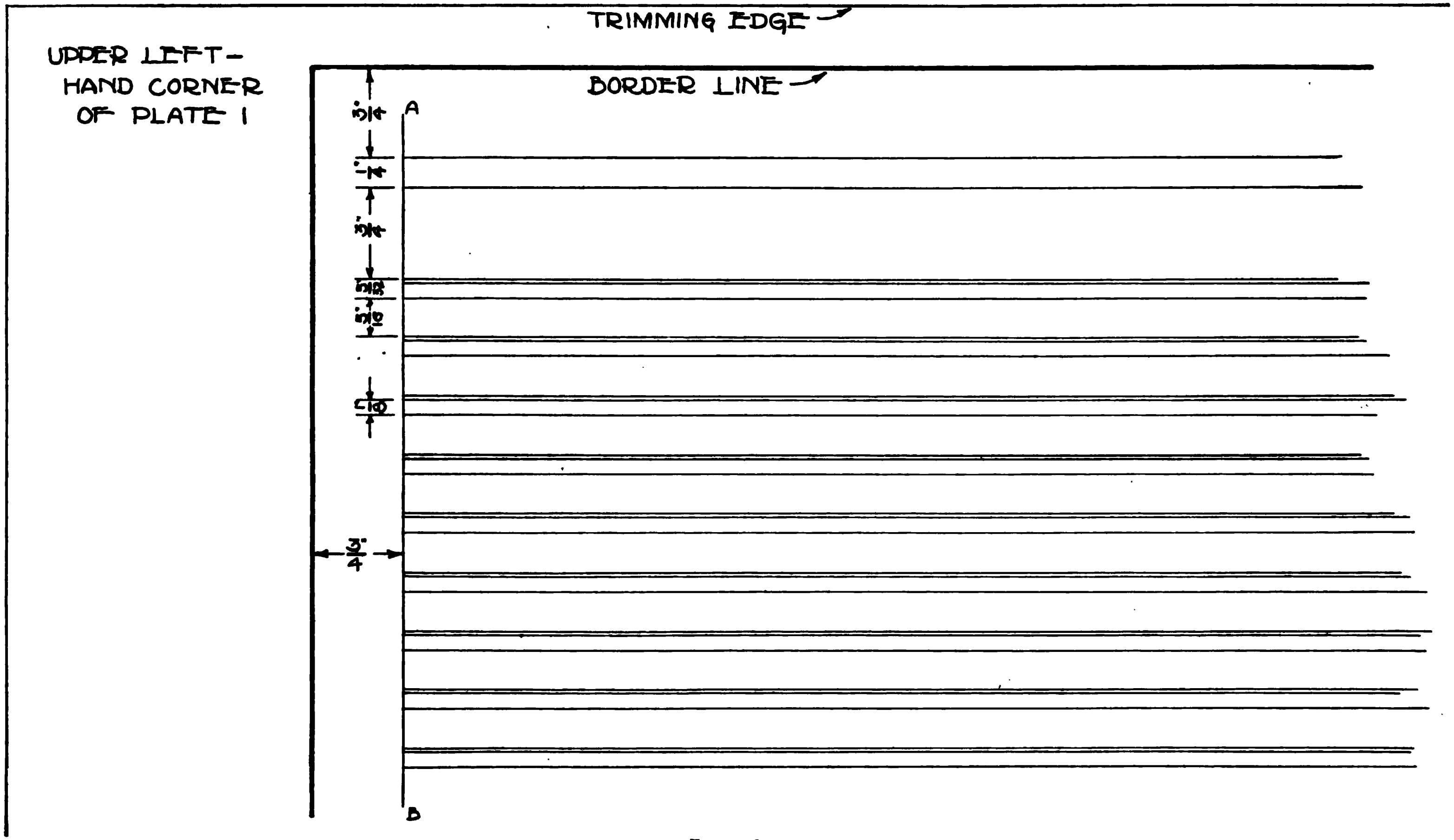

TRIMMING EDGE
UPPER LEFT-HAND CORNER OF PLATE I
BORDER LINE
A
B
3"/4

FIGURE 9.

FREE-HAND LETTERING

ARCHITECTURAL LETTERS AS USED UPON THE MAJORITY OF DRAWINGS ARE ALL VERTICAL FREE-HAND LETTERS. THEY ARE SOMEWHAT NARROWER THAN THEY ARE HIGH AND THE SIZE VARIES WITH THE USE. FOR EXAMPLE, THE TITLES ON THE DRAWING SHEETS SHOULD BE MADE ABOUT $\frac{3}{8}$" HIGH, THE ROOM TITLES ABOUT $\frac{1}{4}$" HIGH, AND THE NOTES ABOUT $\frac{1}{8}$" HIGH. THERE ARE NO UPPER AND LOWER CASE LETTERS-THE CAPS RUNNING A LITTLE HIGHER THAN THE SMALL LETTERS. IT IS THEREFORE NECESSARY TO LEARN BUT ONE STYLE OF ARCHITECTURAL LETTER.

THE STROKE SHOULD BE A FREE AND EASY ONE—NOT CRAMPED AND RESTRICTED. TO OBTAIN THE CORRECT SPACING OF WORDS AND SENTENCES ALL LETTERING SHOULD FIRST BE PENCILED BEFORE INKING.

THE ARCHITECTURAL DRAFTSMAN HAS MORE LIBERTY IN THE CHOICE OF STYLE AND SPACING THAN DOES THE MACHINE DRAFTSMAN, YET THE FUNDAMENTAL PRINCIPLE IS THE SAME—CLEARNESS. DO NOT SPOIL THE EFFECT OF A NEAT DRAWING BY ADDING AN ELABORATE TITLE TO IT, THAT TAKES SOME STUDY TO DECIPHER — A FAULT NOT UNCOMMON WITH SOME BEGINNERS.

A NEATLY LETTERED DRAWING, EVEN THOUGH ITS LINES BE BAD, WILL HAVE A BETTER APPEARANCE THAN AN EXCELLENT DRAWING WITH CARELESS LETTERING.

SLIGHTLY CHANGED STYLES AND COMBINATIONS OF LETTERS ARE PERMISSABLE BUT THEY MUST BE CONSISTENT THROUGHOUT THE DRAWING. FOR COMMON EXAMPLES 'S' MAY BE MADE THUS 'S', 'K' THUS 'K', 'E' THUS 'E' 'LIVING ROOM'

PLATE I.

using first the bow and then the large. Thus the height of the capitals will be 5/32" and the space between the lines, 5/16". The height of the body letters is to be ⅛"; hence set the small bows for that distance and space back into each 5/32" division. Through these points draw light pencil lines. At a point ¾" in from the right-hand border draw a light vertical similar to *A-B*, to guide for the length of the lines.

Copy the data carefully as given upon the plate, being sure of the formation of each letter. Of course the work is to be first penciled, and an effort must be made to keep the letters vertical.

Observe the spacing between the letters and the words. Do not give the plate the appearance of a series of letters, but pull the letters in each word together, and allow ample space between the words.

Take time with this work. Speed will come after the construction has been mastered.

In inking, use the single stroke and a rather heavy pen. Leonardt's ball point No. 506F is very excellent for the two larger sizes, and Gillott's No. 404 for the smaller letters.

When finished, erase all guide lines with a soft cleaning eraser and trim.*

REFERENCES

Frank C. Brown—"Letters and Lettering."

Frank T. Daniels—"A Text-Book of Free-hand Lettering."

French and Meiklejohn—"Essentials of Lettering."

*To the teacher: No directions are given for the location of the plate number and name, as ideas and methods concerning these vary so greatly among teachers that this has been left for them to decide.

CHAPTER III

FOUNDATIONS

No part of the building, apparently, is as much slighted as the foundation of the modern home. Whether it is through false economy upon the part of the owner or close figures upon the part of the builder, it is a matter of fact that this most important part has been neglected and the money that should have been spent upon it has gone into parts that "show."

Walls have been made too thin, poor material has been used, and in the majority of cases, no attempt has been made at waterproofing, which oversight or negligence has resulted in damp, unhealthy cellars, excessive settling of the walls—which means ultimate cracking of the walls and finish, and premature decay in the woodwork.

Foundations built in gravel, a porous material, do not need as much waterproofing as those built in clay. Clay retains the water which settles next to the wall, and capillary action carries it through to the inside and up into the wooden structure.

The expense necessary to combat this evil is spent time and again in repair and doctor's bills, and it is strongly urged that the student, when he comes to build a home of his own, should bear these facts in mind.

There is a number of methods of waterproofing, depending, of course, upon the character of the soil and the material of the foundation.

Foundation Materials. There are five very excellent materials that can be used for residence foundations, any one of which is recommended. Comparative cost of each is about as follows, laid in place upon the wall:

Material	Price per 100 Cubic Feet
Cement Block	$19.00
Concrete	20.00
Hollow Tile	22.00
Hard Brick	24.00
Rubble Stone	26.00

As stated above, this table is only comparative, and the prices may vary in different localities. For instance, where stone abounds and sand is scarce, it may be cheaper to construct a stone foundation than one of concrete or cement blocks.

Combination foundations are coming to be looked upon with favor, and, if properly made, there is no objection to them. For example, a monolithic—that is, a solid concrete wall—can be built up to the grade line, and brick or stone topped where the wall is visible from the outside, thereby giving it the appearance and stability of a solid brick or stone wall at a less cost.

Waterproofing. There are two common methods of waterproofing foundations, the *integral* and the *external*, or *surface* treatments. The former, applicable only to the monolithic or the cement block walls, has three subdivisions: First, the introduction of special patent waterproofing materials into the concrete mass when mixing. These may be in the form of powder, paste, or liquid, and, if a reliable and tested material has been selected, they give excellent results, as they waterproof the entire mass. Regarding their action, a consideration of one of them, "Ceresit," will be interesting.

It is a paste that is mixed with water, fifteen to twenty parts of water to one of the paste. When thoroughly dissolved, this is used to temper the dry concrete mixture in place of water alone. The concrete mixture, it will be understood, consists of one part of Portland cement, two to three parts of well graded sand, and four to five parts of clean crushed stone or gravel, well mixed in the mass.

The "Ceresit," according to the claims made for it, destroys the capillary action in the cement, rendering it not only waterproof, but repellant.

The second integral method is to use Portland cement that has been specially treated in the process of manufacture, so that, when it comes from the mills, it already contains all the waterproofing elements required.

The third is the use of a rich mixture of ordinary Portland cement with the sand and stone, well graded and thoroughly tamped, so as to make the concrete more dense. Builders are beginning to realize this value, and are using wetter mixtures and finer materials. Regarding *external*, or *surface*, treatments that may be applied to any wall—either concrete, tile, brick, or stone much can be said. The first of these is illustrated in Figure 10—the application of washes to the outside of the wall. These washes are of various materials, asphalt and hot tar being commonly used. Then again, a rich plaster of cement and sand mortar, put upon the wall when green, preferably, will serve. There are also various patent washes on the market, some of which depend upon chemical action for their waterproofing results. One of these consists in the application of alternate washes of hot solutions of castile soap and alum, the combination of which forms an insoluble compound which effectively fills the pores of the structure.

The second method, illustrated in Figure 11, can be used to waterproof old as well as new walls, and is very similar to the first excepting that the waterproofing material is used upon the inside instead of the outside of the wall. Any of the materials mentioned for the first method can be used, but a cement mortar coating into which has been introduced such a material as "Ceresit" will give the best results. This mortar should be mixed as follows:

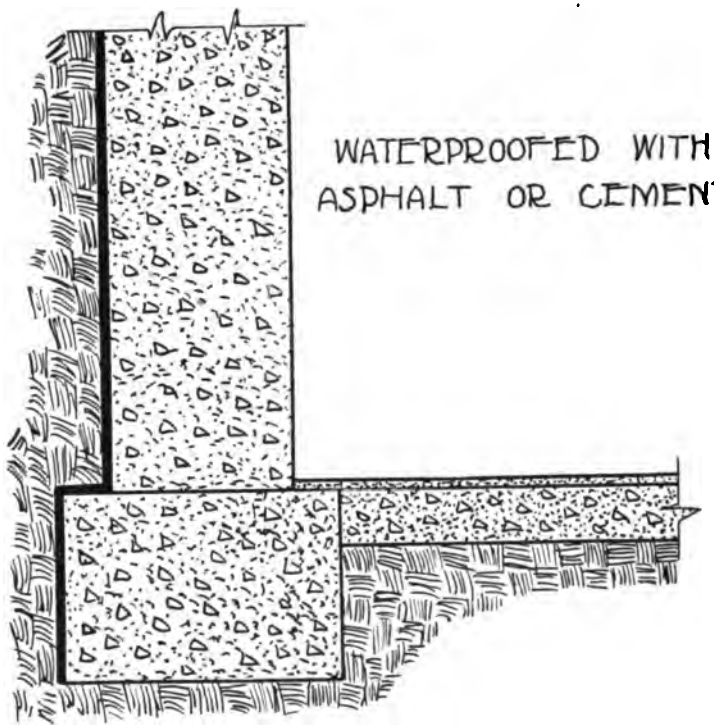


FIGURE 10.

A solution of one part of the paste to twelve parts of water should be used to temper a mixture of one part of Portland cement to two parts of sharp, well sifted sand.

By using a waterproofing material upon the *inside* of the

wall, results are not as effective as they are if the first method is employed, as the moisture is then inside the wall and is only kept from the celler by the thin coating of cement.

Footings. The footing, meaning the part below the wall proper, for any kind of foundation should be made of con-

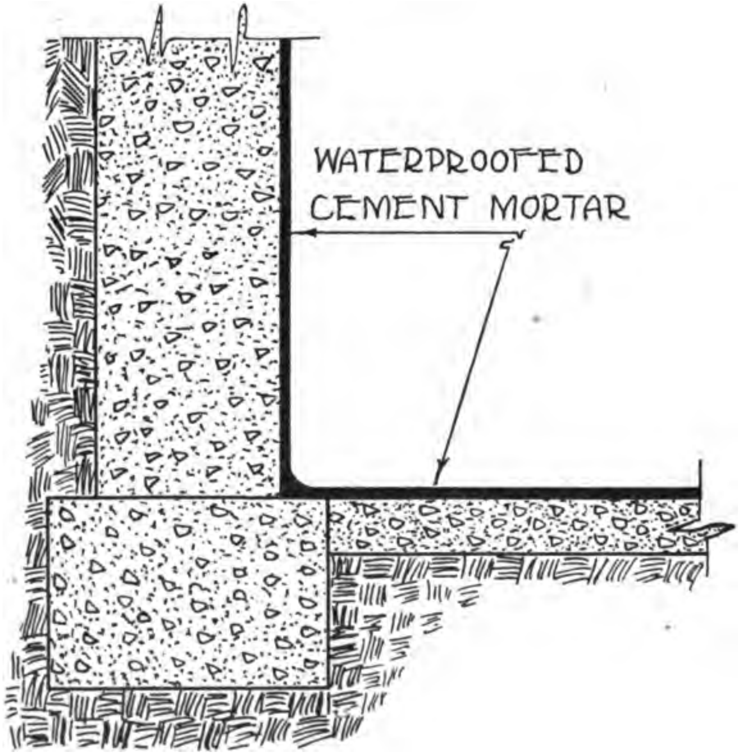


FIGURE 11.

crete. It should be at least six inches wider than the wall it supports, twelve is better, and, for residences, twelve inches deep. It is made up under the same formula as the monolithic wall and usually built without forms.

Basement Floors. Although three inches, and even two, in some cases, have served as the thickness of a cement floor, nothing under four inches is recommended—three and one

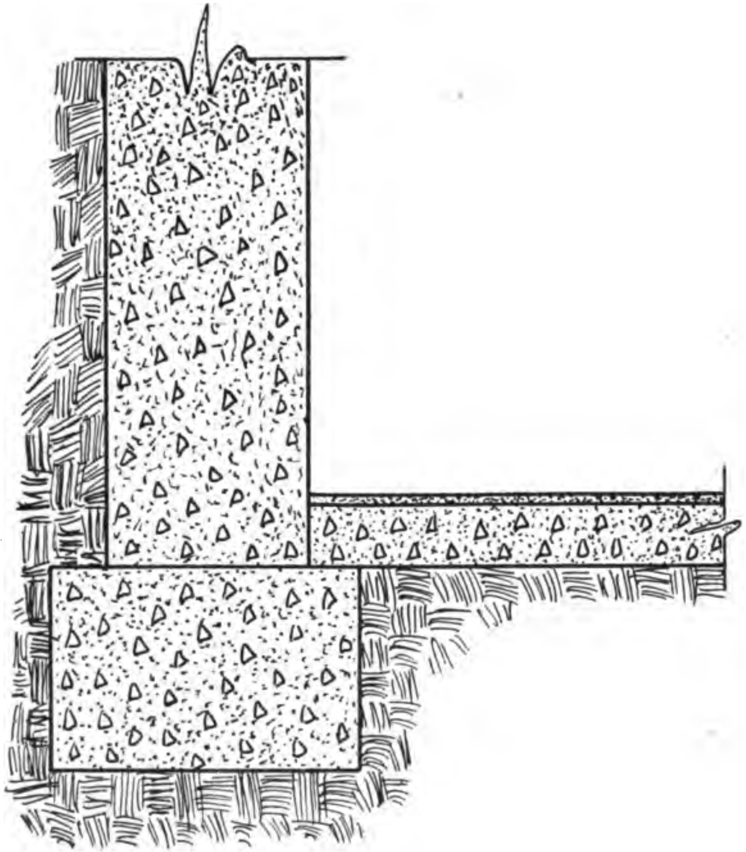


FIGURE 12.

half of concrete, and one half of top dressing. The additional cost is not great, and the permanence of the floor is assured.

There are various methods of laying these floors. In some

instances the concrete base is set upon the wall footing, as illustrated in Figure 12, while in others, as shown in Plate II, the base comes on a level with the top of the footing, and the dressing covers both. This latter method has several advantages over the former. It adds three and one half inches to the height of the basement with the same height of wall, and, if the floor should settle more than the wall, it can drop without cracking. On the other hand, any slight settling might be prevented by the footing, if the floor extended over it. Either method is good, if the work is well done, and both are used in various sections of the country. The cement and concrete used in the floor should be waterproofed to assure their perfect satisfaction.

Thickness of Walls. There was a time when builders made foundation walls for one story cottages 30″ thick, which, as they must have figured it, was none too strong. Nowadays some apparently think that an 8″ wall is sufficient for a two story house; but it certainly is not, especially below the grade line. No solid concrete wall should be put up less than 12″ in thickness. If a very good grade of cement blocks are purchased, three tiers of 8″ blocks upon the 12″ wall may be used with success, but nothing under 12″ is recommended. For a brick wall, three bricks are laid side by side, which, with the bonds of mortar, will make the wall 13″ in thickness. It is about as cheap to build a rubble stone wall 16″ thick as it is to build it 12″ thick; hence the 16″ wall is recommended.

All foundations should be set in cement rather than in lime-mortar, or in a mortar composed of both cement and lime.

Instructions for Drawing Plate II

Margins same as Plate I.

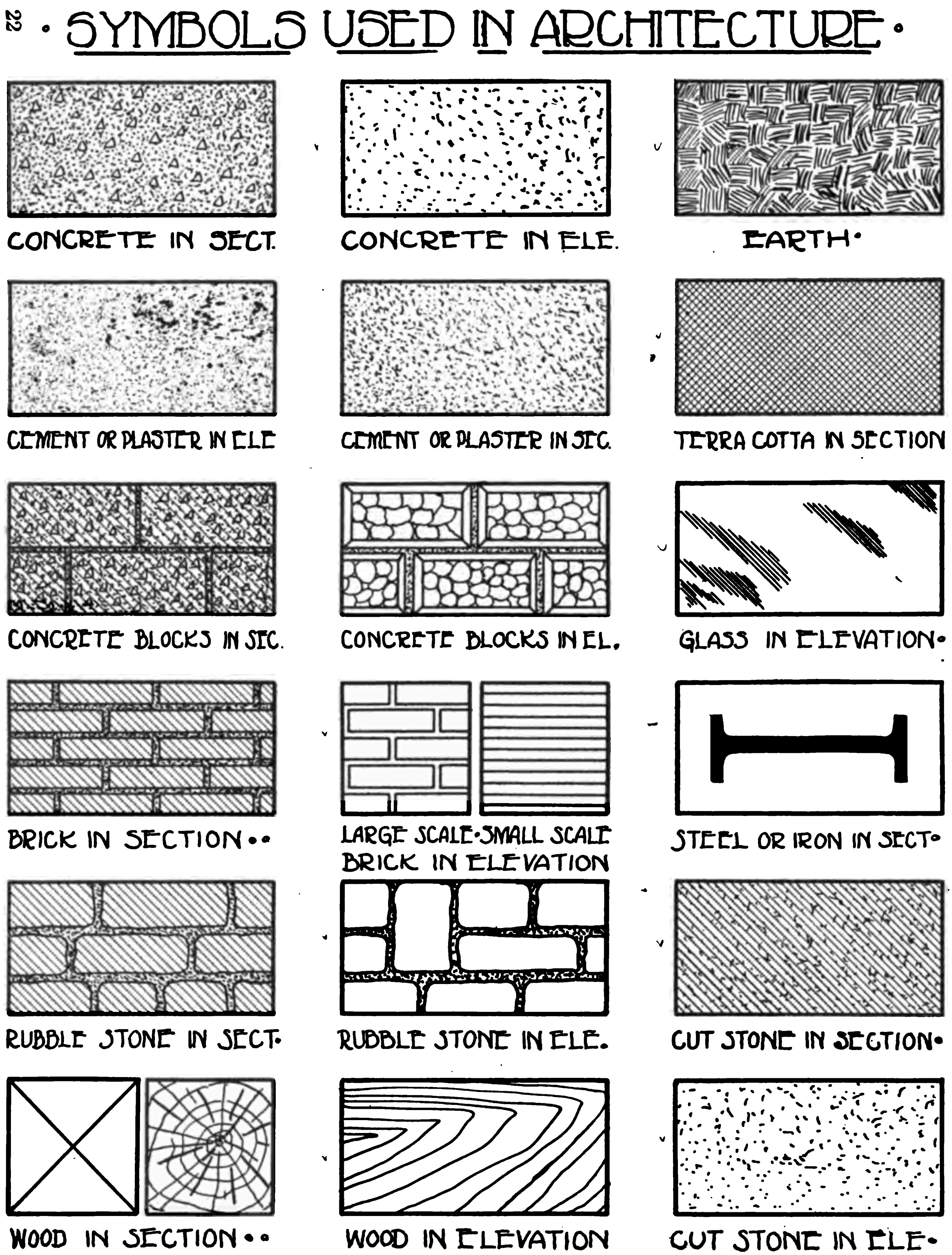
This plate should be drawn to the scale of 1 inch equals 1 foot, and worked up from the dimensions given on the drawing and from the text. Where dimensions that are needed are not shown, the scale in the lower right-hand corner will accurately find them.

Pencil in all outlines, but do not put in the cross hatching and symbols except in ink alone. Figure 13 illustrates the common symbols used in architecture.

If the teacher so desires, instead of cross hatching, the sections may be tinted, in which case it will be necessary to stretch the paper so that it will not wrinkle when wet and remain wrinkled after it has been finished.

Directions for Shrinking Drawing Paper

Place the paper on the board with face side up. Fold up about ½ to 1 inch of the margin on all sides so that the paper will resemble a shallow box. Turn the paper over so as to rest on the turned-up edges. With a clean sponge and water dampen all the surface of the paper except the turned-up edges upon which apply the paste, glue, or mucilage. Then wipe off all the water from paper and turn right side up. Rub down and stretch the top and bottom edges of paper first. Be sure to leave no wrinkles either in the edges or in the corners. The other edges are then treated in the same manner. The edges must be kept straight. If no wrinkles are left in edges or corners, the paper will dry smooth. The paper must be allowed to dry slowly; if placed in sun or heated, it will get too dry and wrinkle when exposed to an ordinary temperature. To avoid streaks in paper, use clean water and sponge, wipe off all water, and have board flat when placed to dry. Be sure no water gets on the margin of paper used for paste and that no paste gets on the middle of drawing board or inside the dry edges of paper, to cause trouble in cutting off the paper when the drawing is finished. In large drawings both sides of the paper are wet, but it is best not to wet the face when stretching the paper, because the surface is lost and then the



· SYMBOLS USED IN ARCHITECTURE ·
CONCRETE IN SECT.
CONCRETE IN ELE.
EARTH·
CEMENT OR PLASTER IN ELE
CEMENT OR PLASTER IN SEC.
TERRA COTTA IN SECTION
CONCRETE BLOCKS IN SEC.
CONCRETE BLOCKS IN EL.
GLASS IN ELEVATION·
BRICK IN SECTION··
LARGE SCALE·SMALL SCALE
BRICK IN ELEVATION
STEEL OR IRON IN SECT·
RUBBLE STONE IN SECT·
RUBBLE STONE IN ELE.
CUT STONE IN SECTION·
WOOD IN SECTION··
WOOD IN ELEVATION
CUT STONE IN ELE·

FIGURE 13.

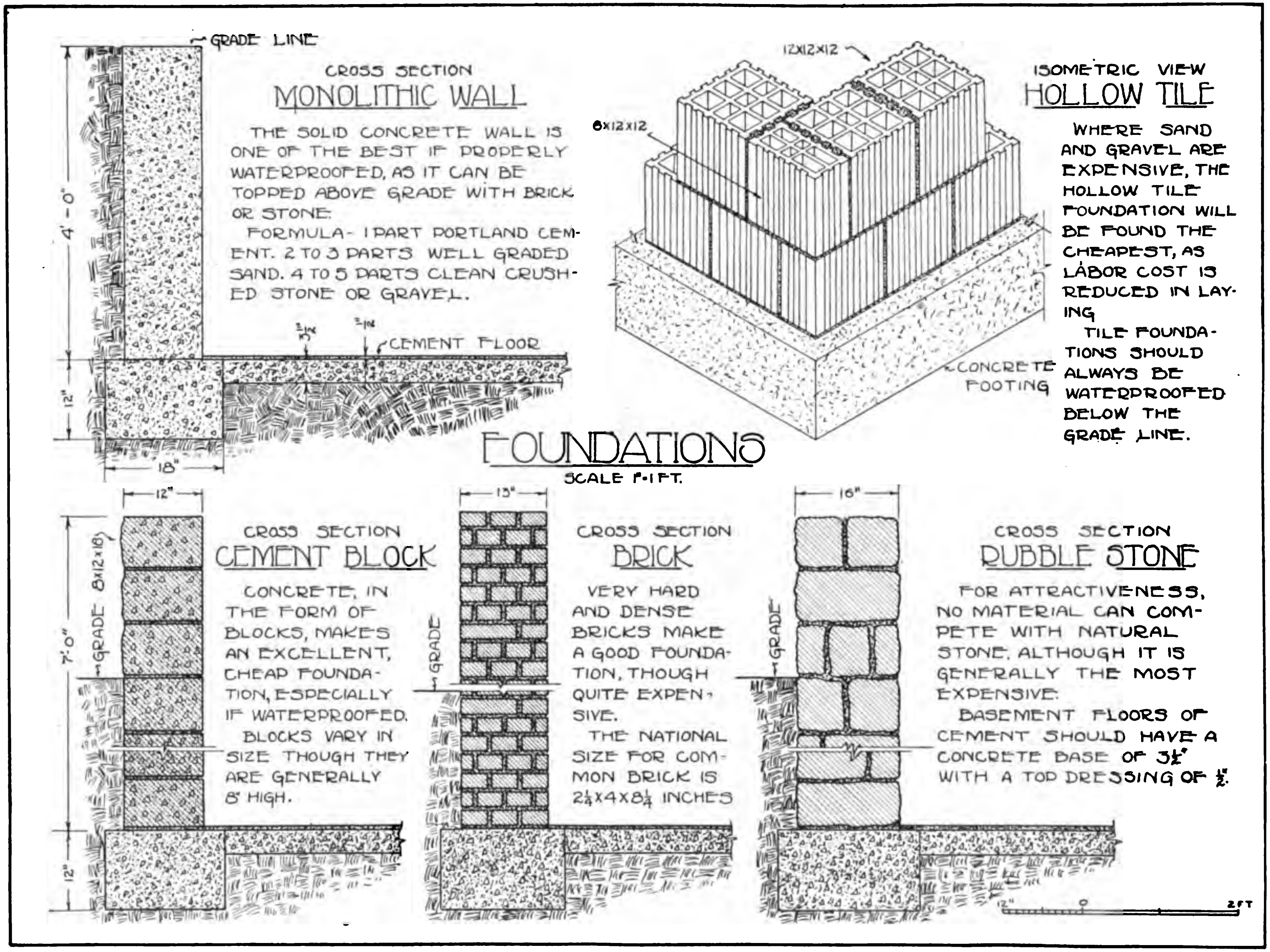

FOUNDATIONS
SCALE 1"=1 FT.
GRADE LINE
CROSS SECTION
MONOLITHIC WALL
THE SOLID CONCRETE WALL IS ONE OF THE BEST IF PROPERLY WATERPROOFED, AS IT CAN BE TOPPED ABOVE GRADE WITH BRICK OR STONE.
FORMULA- 1 PART PORTLAND CEMENT. 2 TO 3 PARTS WELL GRADED SAND. 4 TO 5 PARTS CLEAN CRUSHED STONE OR GRAVEL.
CEMENT FLOOR
4'-0"
12"
18"
12X12X12
8X12X12
ISOMETRIC VIEW
HOLLOW TILE
WHERE SAND AND GRAVEL ARE EXPENSIVE, THE HOLLOW TILE FOUNDATION WILL BE FOUND THE CHEAPEST, AS LABOR COST IS REDUCED IN LAYING
TILE FOUNDATIONS SHOULD ALWAYS BE WATERPROOFED BELOW THE GRADE LINE.
CONCRETE FOOTING
12"
8X12X18
GRADE
7'-0"
CROSS SECTION
CEMENT BLOCK
CONCRETE, IN THE FORM OF BLOCKS, MAKES AN EXCELLENT, CHEAP FOUNDATION, ESPECIALLY IF WATERPROOFED.
BLOCKS VARY IN SIZE THOUGH THEY ARE GENERALLY 8" HIGH.
13"
GRADE
CROSS SECTION
BRICK
VERY HARD AND DENSE BRICKS MAKE A GOOD FOUNDATION, THOUGH QUITE EXPENSIVE.
THE NATIONAL SIZE FOR COMMON BRICK IS 2¼X4X8¼ INCHES
16"
GRADE
CROSS SECTION
RUBBLE STONE
FOR ATTRACTIVENESS, NO MATERIAL CAN COMPETE WITH NATURAL STONE, ALTHOUGH IT IS GENERALLY THE MOST EXPENSIVE.
BASEMENT FLOORS OF CEMENT SHOULD HAVE A CONCRETE BASE OF 3½" WITH A TOP DRESSING OF ½".
12"
0
2 FT

PLATE II.

paper soon becomes soiled. Do not attempt to draw on paper until it is completely dry and smooth.

Tinting. A drawing that is to be tinted must be made carefully with lead pencil and, if possible, without erasing, as the surface to be tinted, if rubbed or scratched, will be likely to show when finished. The drawing can be tinted without inking in, if all lines that are not to be inked are removed. A lead pencil line when wet becomes almost indelible and difficult to erase. If the drawing is *inked* in first, the paper must, when the ink is dry, be washed with plenty of clear water to remove any superfluous ink that would cause dirty colored tints in the drawing. Do not rub paper hard with sponge or the surface will be injured.

When the surfaces are to be tinted, the drawing board can be slightly inclined so that the color may flow easily in one direction. The surfaces can be wet with clear water before the color is applied and more even tints will then be secured than if the color is applied at once to the hard dry surface of the paper. The most common way is to use a double end brush, the large end to hold clear water for blending, the small end to hold the color. With considerable color in the brush, but not nearly all it will hold, commence at the top of the surface to be tinted and follow it carefully with the first stroke. Before the color dries at the top, lay on the color below by moving the brush back and forth, using enough color in the brush so that it will flow gradually, with the help of the brush, towards the bottom. The lines must be followed carefully at first, and the brush not used twice over the same place while surface is wet or streaks will form. Do not paint the colors on, but allow them to flow quite freely after the brush.

It is best to protect the drawing with a sheet of paper and expose only the surface needed. Clean blotters are useful in many ways—a blotter with ink on it should never be used when tinting surfaces, as the ink might ruin the colored surface.

Be sure your brushes are clean and never put a brush away until cleaned and with the hair drawn to a point in proper condition to dry. Tints must be mixed with clean water, kept stirred up and free from dust. Try to tint a surface with one brushful of color, if possible. If a heavy color is desired, it is best to apply several washes.

Colors. In the small boxes of water colors will be found the primary colors, red, yellow, and blue. These, in various proportions, can be used to produce the tints necessary. The following are suggested:

Brick—red, yellow, and a little blue.

Tile—same as brick.

Concrete or cement—red, yellow, and blue in equal proportions, thinned out, and speckled with India ink

Earth—yellow with a little red and blue

Stone—blue

Plaster—light blue, speckled

Wood—yellow

Water—blue with a little yellow

Iron—dark blue (indigo)

If the more expensive boxes of paints are used in which the colors are already mixed, use as follows:

Brick and tile—light red

Concrete or cement—black thinned out and a little Chinese white added—speckled with ink

Earth—yellow ochre

Stone—Prussian blue

Plaster—cobalt blue, speckled

Wood—gamboge

Iron—indigo blue

REFERENCES

Greenberg and Howe—"Architectural Drafting."
F. E. Kidder—"Building and Construction," Part I.
Wm. A. Radford—"Cement Houses and How to Build Them."
Wm. Arthur—"Home Builders' Guide."
Various trade catalogues, especially those of the cement companies.

CHAPTER IV

FRAMING

There are, generally speaking, two ways to build the wooden framework of a house—*braced* framing, as practiced in the East and South, and *balloon* framing in the West. There are modifications and combinations of both types, yet these two form the main divisions.

The Eastern type—the *braced* frame—is illustrated in Plate III. A heavy timber, called the "sill" is bedded in mortar on the foundation wall. Its corners are either half-lapped, as illustrated, or mortised together, and pinned. Into each corner is mortised a post 4″ by 8″, which is braced. The studding is all mortised into the sill, at the lower end, and into a heavy piece at the second floor line called the "girt." The girt also supports the second floor "joists." The attic joists are supported on a "ledger board," sunk into the studding at a point a little below the top member, which is known as the "plate." Diagonal "wind braces" are placed from the corner post to the sill, girt, and plate. These various parts are all illustrated in the drawing.

In the balloon frame there are no braces or girts. The "sill" is usually built up of planks, the first floor joists spiked to it, and the rough floor laid. Then the floor plates are spiked and the studs toe-nailed into place with a "plate" on their upper ends. The second floor joists are supported with a "ledger board," let into the studding. The upper plate, corner posts, and opening headers are usually doubled.

There is also a combination frame in which the sill is a heavy timber, such as used in the Eastern type, while the rest of the construction is very similar to the balloon frame, all parts being spiked together. This style usually has light wind braces at the corners.

Comparison of Methods. A comparison of these types is a rather difficult matter. They are both good; but, geographically considered, they should be reversed. The high winds and tornadoes of the West should command the more rigid frame, theoretically; yet it is found that the balloon frame, in most cases, is sufficiently strong. As it has been in use only since 1850, little can be told concerning its real lasting qualities, while braced frame buildings have been known to stand for two hundred years or more, with no other damage than the rotting of the sills. If it were not for this rotting away, there is no reason to doubt that a well braced frame would stand until the end of time.

Economically considered, the Western method has a great advantage over the Eastern. With the smaller timbers, which cut down the price of material, and the very rapid construction possible, which minimizes the cost of labor, the balloon frame is much the cheaper. With an equal number of men at work, a home in the West will be built and occupied in about the same length of time that it takes to frame the Eastern house.

The Western style also has another advantage. Being spiked instead of mortised, the different members retain their full strength, and no "pockets" are formed in which moisture can collect and rot the structure. A builder of many years experience states that he has never torn down a braced frame building that he did not find the tenons rotted off the ends of the studs at the sill.

Instructions for Drawing Plates III and IV

Margins same as Plate I.

Carefully study the Plates before drawing a line, to be very sure that you understand the constructions. In Plate III,

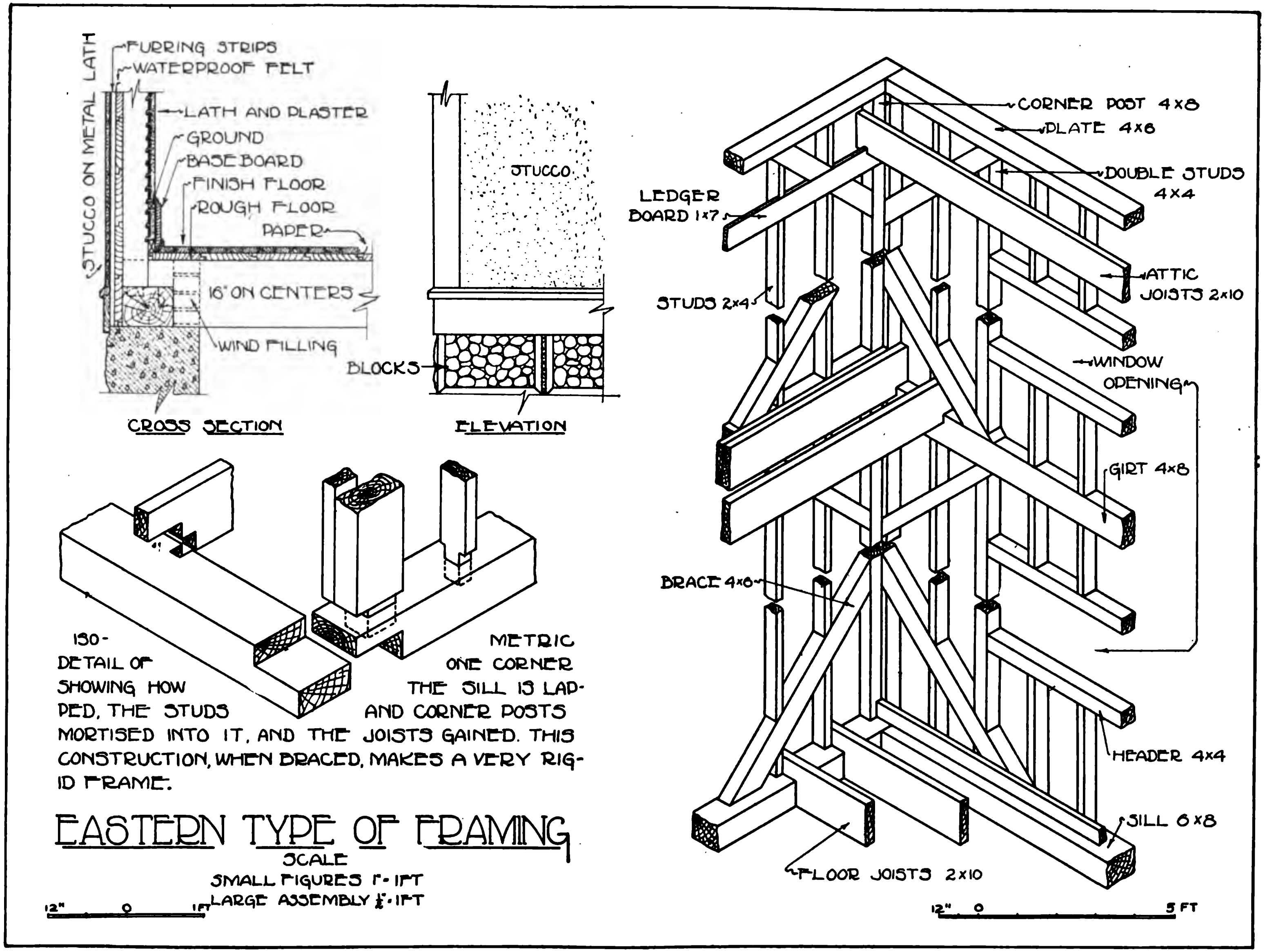
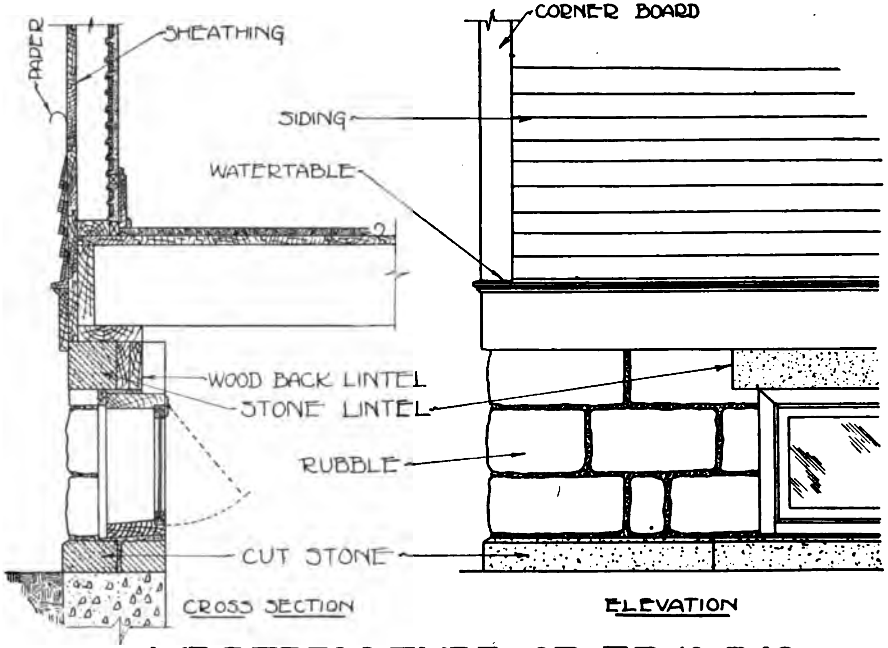

FURRING STRIPS
WATERPROOF FELT
STUCCO ON METAL LATH
LATH AND PLASTER
GROUND
BASEBOARD
FINISH FLOOR
ROUGH FLOOR
PAPER
16" ON CENTERS
WIND FILLING
CROSS SECTION
STUCCO
BLOCKS
ELEVATION
ISO-METRIC DETAIL OF ONE CORNER SHOWING HOW THE SILL IS LAPPED, THE STUDS AND CORNER POSTS MORTISED INTO IT, AND THE JOISTS GAINED. THIS CONSTRUCTION, WHEN BRACED, MAKES A VERY RIGID FRAME.
EASTERN TYPE OF FRAMING
SCALE
SMALL FIGURES 1"-1FT
LARGE ASSEMBLY ½"-1FT
12" 0 1FT
CORNER POST 4x8
PLATE 4x8
DOUBLE STUDS 4x4
LEDGER BOARD 1x7
ATTIC JOISTS 2x10
STUDS 2x4
WINDOW OPENING
GIRT 4x8
BRACE 4x6
HEADER 4x4
SILL 6x8
FLOOR JOISTS 2x10
12" 0 5 FT

PLATE III.



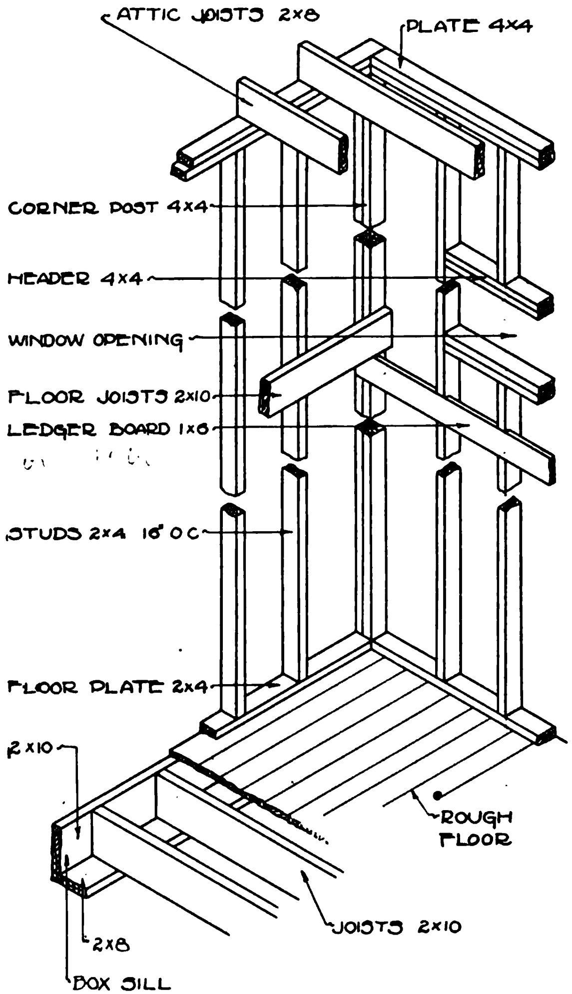
WESTERN TYPE OF FRAMING

SCALE
ABOVE FIGURES 1"=1FT.
ISOMETRIC VIEW ½"=1FT.

IN THE WESTERN TYPE OF FRAMING—COMMONLY CALLED "BALLOON" FRAMING—PRACTICALLY NO JOINTS ARE CUT. THIS INSURES FULL STRENGTH OF EACH PIECE. ALL JOINING IS DONE BY NAILING. THE STUDS RUN FROM THE FLOOR TO THE PLATE, AND THE SECOND FLOOR JOISTS REST UPON A "LEDGER BOARD," OR "RIBBON," WHICH IS LET INTO THE STUDDING. THE "BOX SILL" IS ANOTHER DEPARTURE TYPICAL OF THE WEST. INSTEAD OF ONE SOLID PIECE BEING USED, TWO PLANKS ARE SPIKED TOGETHER, FORMING AN "L."

ALTHOUGH A FRAME OF THIS TYPE IS CERTAINLY NOT AS RIGID AS A FULL BRACED FRAME, THE SHEATHING—ESPECIALLY IF PLACED DIAGONALLY—ADDS SO MUCH TO ITS STRENGTH THAT THE DIFFERENCE IN THE FINISHED STRUCTURES IS HARDLY NOTICABLE UNLESS CONDITIONS ARE SEVERE.

12" 0 1FT 3FT



12" 0 1FT 6FT

PLATE IV.

the cross-section at the sill line, the elevation of same, and the enlarged detail of construction, are to be drawn to the scale of 1 inch equals 1 foot, and the large isometric—½ inch equals 1 foot. In Plate IV, the section and elevation to the scale of 1 inch equals 1 foot, and the isometric ½ inch equals 1 foot. For the various sizes of mouldings, etc., consult the following, which, in each case, gives the finished mill size.

Name of Material	Thickness	Width
Baseboard	13-16″	7¼″
Carpet strip	½″	⅞″
Water table drip cap	1⅛″	2½″
Cove under drip cap	¾″	⅞″
Base of water table	13-16″	5¼″
Lath	5-16″	1½″
Finish floor	13-16″	2¼″
Rough floor	13-16″	5¼″
Sheathing	13-16″	5¼″
Beveled siding	½″	4 ″
Grounds	13-16″	1½″
Grounds	13-16″	13-16″

The framing lumber is scaled as being the full size specified upon the drawing, although in actual practice the dimensions are found to be a fraction smaller.

A detail of the cellar window illustrated in Plate IV is given in Figure 14. Its principal dimensions are as follows:

Name of Part	Thickness	Width	Height
Plank sash jamb	1¾″	7½″	......
Moulding	1⅛″	1¾″	......
Sash, outside measurements	1⅜″	26″	15″

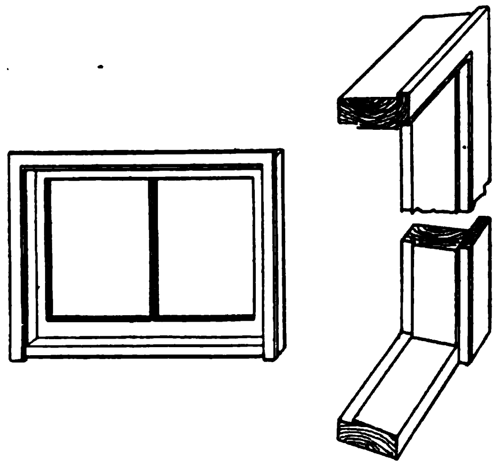


FIGURE 14.

A stone lintel 6″ by 6″ runs across the opening, backed, even with the edge of the sill, by a wood lintel. The frame is set in cement mortar, and the sash is hinged at the top.

In some cases the lintel is omitted, thereby giving six inches additional height for the window; but this practice is not the best, as there is nothing to support the wall above the opening except the wooden frame.

REFERENCES

Wm. Radford—"Practical Carpentry."
American School of Correspondence—"Carpentry, Part I."
Chas. A. King—"Constructive Carpentry."
C. A. Martin—"Details of Building Construction."

CHAPTER V

MOULDINGS

In our analysis of building construction, we are constantly encountering various forms of mouldings—both exterior and interior; hence we will consider them in detail before working into the larger assembly forms.

The standard mouldings, as adopted by the builders throughout the country, are delineated from the classical mouldings of the ancient Greeks and Romans. The Greek shapes were principally composed of irregular curves—parts of the ellipse and hyperbola, while the Roman mouldings were formed of parts of circles. Figure 15 illustrates seven of the principal forms of classical Roman mouldings, and a comparison of them with the modern forms shown on Plates V and VI will show the relation between them.

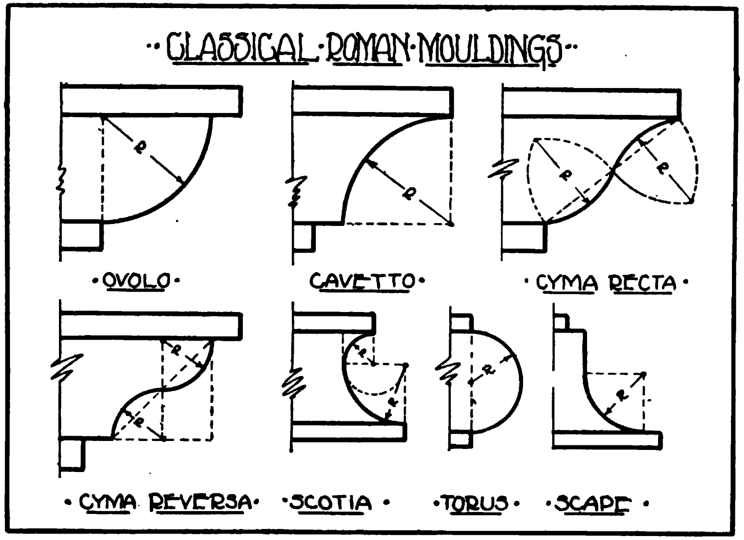


FIGURE 15.

As stated, the various modern mouldings are the result of a careful study of the ancient Greek and Roman forms—principally the latter. The Greeks cut mouldings without any regard for the expenditure of time and labor, resulting in beautiful ornate forms that are very difficult to reproduce under modern conditions. The effect of light and shade across the surface of a moulding was of utmost importance to the ancient Greek designers; hence Greek mouldings are indisputably more perfect in form and more distinctive in appearance than any variation that we are likely to invent to-day. Another object of the Greeks in the design of their moulding forms was to provide a drip to throw off the water running over them, so as to protect the face of the stonework below.

The Greek moulding sections seldom contain arcs of true circles—the ellipse and other conic sections being prominent, while the Roman mouldings, almost without exception, are the combination of arcs and straight lines; hence one reason for our modern adoption of them.

All Greek mouldings may be indefinitely varied to suit their location and purpose. They may have more or less sharpness of outline—sharpness results from marked projections—or a bluntness resulting from slight projections. A "limp" outline results when all the mouldings are of equal importance. Greek mouldings were further complicated with carving, or even with painting, but variety in ornaments was not carried to an excess. In architecture mouldings are only accessories, and, therefore, they should not be too striking nor capable of long detaining the attention from the main object, which is the point to be emphasized.

When ornaments were applied to decorate a profile, some of

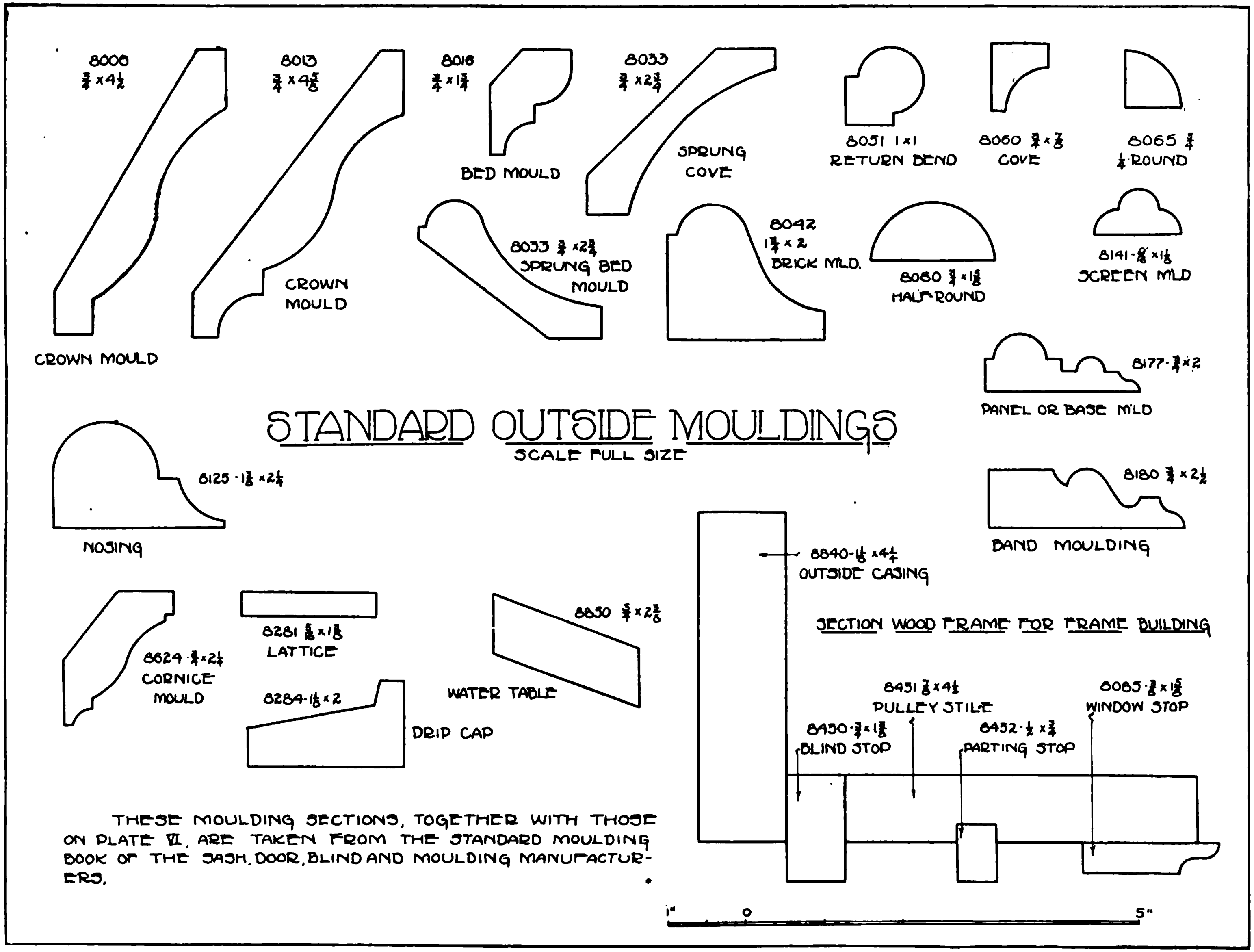

8008 3/4 x 4 1/2
CROWN MOULD
8013 3/4 x 4 5/8
CROWN MOULD
8016 3/4 x 1 3/4
BED MOULD
8033 3/4 x 2 3/4
SPRUNG COVE
8051 1 x 1
RETURN BEND
8060 3/4 x 7/8
COVE
8065 3/4
1/4 ROUND
8033 3/4 x 2 3/4
SPRUNG BED MOULD
8042
1 3/4 x 2
BRICK MLD.
8080 3/4 x 1 5/8
HALF-ROUND
8141-5/8 x 1 1/8
SCREEN MLD
8177-3/4 x 2
PANEL OR BASE MLD
STANDARD OUTSIDE MOULDINGS
SCALE FULL SIZE
8125-1 1/8 x 2 1/4
NOSING
8180 3/4 x 2 1/2
BAND MOULDING
8840-1 1/8 x 4 1/4
OUTSIDE CASING
8624 3/4 x 2 1/4
CORNICE MOULD
8281 5/16 x 1 3/8
LATTICE
8850 3/4 x 2 3/4
WATER TABLE
8284-1 1/8 x 2
DRIP CAP
SECTION WOOD FRAME FOR FRAME BUILDING
8451 7/8 x 4 1/2
PULLEY STILE
8085 1/2 x 1 5/8
WINDOW STOP
8450 3/4 x 1 5/8
BLIND STOP
8452 1/2 x 3/4
PARTING STOP
THESE MOULDING SECTIONS, TOGETHER WITH THOSE ON PLATE VI, ARE TAKEN FROM THE STANDARD MOULDING BOOK OF THE SASH, DOOR, BLIND AND MOULDING MANUFACTURERS.
1"
0
5"

PLATE V.

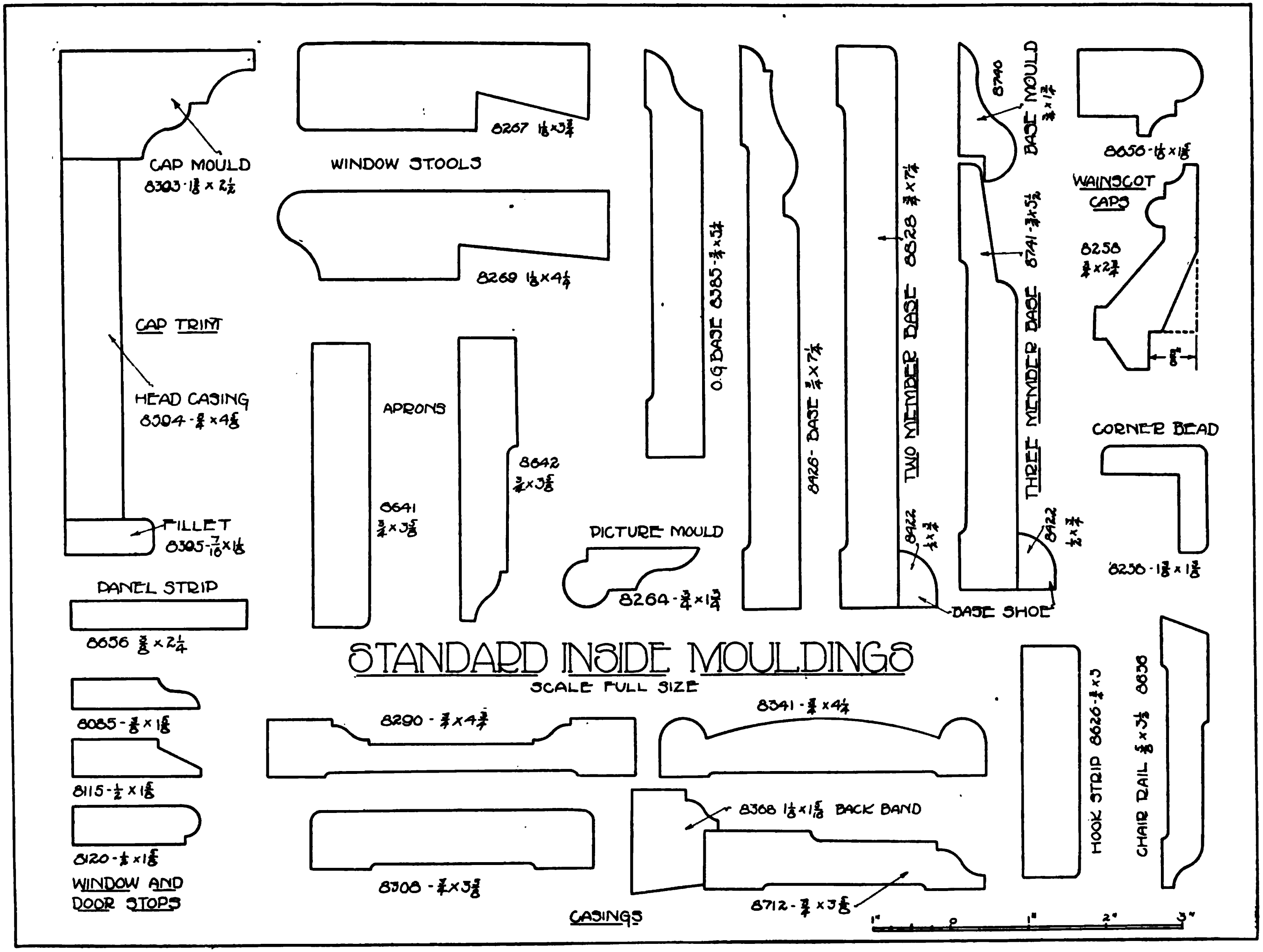

STANDARD INSIDE MOULDINGS
SCALE FULL SIZE
CAP MOULD
8303 - 1⅛ x 2½
WINDOW STOOLS
8267 1⅛ x 3¾
8269 1⅛ x 4¼
CAP TRIM
HEAD CASING
8304 - ⅞ x 4⅝
FILLET
8305 - 7/16 x 1⅛
APRONS
8641
¾ x 3⅝
8642
¾ x 3⅝
PICTURE MOULD
8264 - ¾ x 1¾
O.G BASE 8385 - ¾ x 5¼
8426 - BASE ¾ x 7¼
TWO MEMBER BASE 8828 ¾ x 7¼
8422
½ x ¾
BASE SHOE
8740
BASE MOULD
¾ x 1¾
THREE MEMBER BASE 8741 - ¾ x 5¼
8650 - 1⅛ x 1⅜
WAINSCOT CAPS
8258
¾ x 2¾
CORNER BEAD
8230 - 1⅜ x 1⅜
PANEL STRIP
8656 ⅜ x 2¼
8085 - ⅜ x 1⅜
8115 - ½ x 1⅜
8120 - ½ x 1⅜
WINDOW AND DOOR STOPS
8290 - ¾ x 4¾
8341 - ¾ x 4¼
8308 - ¾ x 3⅝
8368 1⅛ x 1⅜ BACK BAND
8712 - ¾ x 3⅝
CASINGS
HOOK STRIP 8626 - ⅞ x 3
CHAIR RAIL ⅝ x 3⅛ 8836
1" 0 1" 2" 3"

PLATE VI.

the mouldings were left plain, in order to form a proper repose; for, when all are enriched, the figure of the profile is lost in confusion, or a "limp" and unpleasant outline is formed.

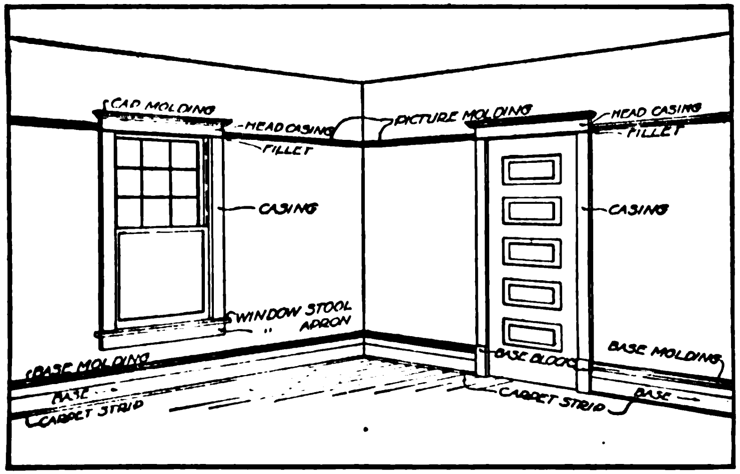


FIGURE 16.

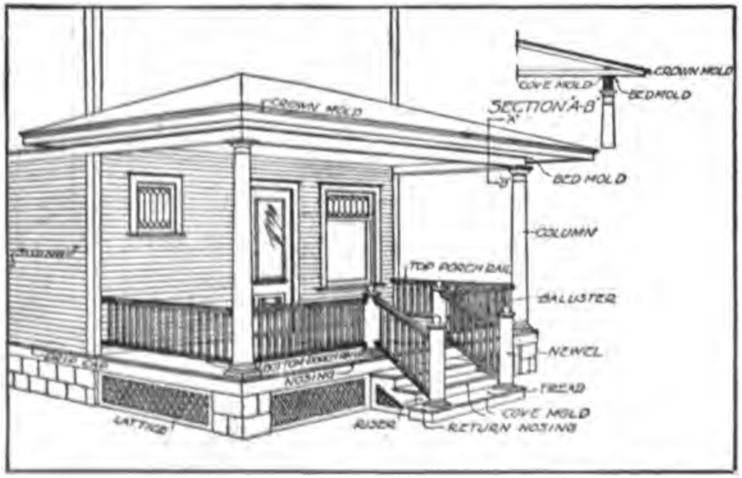


FIGURE 17.

The *ovolo* is now spoken of as the *quarter round*, the *cavetto* as the *cove*, while the *torus* has its modern counterpart in the *fillet*, *half round*, and *bead*. The *cyma reversa*, or *ogee* mould, has been adapted to a form of interior finish, very popular at present, and known as the *O. G.*

Referring to the Plates, all mouldings represented are taken from the standard stock designs of the mills all over the country. Each piece has its own number, and is so labeled upon the drawings. All the designs, and a great many others, are given in "The Standard Moulding Book," of the Sash, Door, Blind, and Moulding Manufacturers of the Northwest.

It is much cheaper for the builder to plan on using such stock mouldings, than it is to design and specify special forms which require the making of new and unusual cutters for the moulding machines. Most mills, in addition to the "Standard" designs, carry some line of "Mission" or "Craftsman" shapes, which, if that style of trim is desired, will also be much cheaper to use than some special, individual design. The various catalogues illustrate these styles.

Figures 16 and 17 show the various uses for most of the common mouldings illustrated upon the Plates.

Instructions for Drawing Plates V and VI

Margin same as Plate I.

All the forms given upon the Plates are to be drawn full size. If possible, sections of the mouldings themselves would be very helpful, and a copy of "The Standard Moulding Book" would prove invaluable.

REFERENCES

American School of Correspondence—"The Orders, Part I."
Wm. R. Ware—"The American Vignola."
A. D. F. Hamlin—"History of Architecture."
"The Standard Moulding Book."

CHAPTER VI

DETAILS OF BUILDING CONSTRUCTION

With the completion of the foundation wall, which is essentially the same for all frame buildings, the walls of the structure are begun.

Wall and Sill Construction. In the Western type, as was illustrated in Plate IV, the sills are composed of planks spiked together forming an "L." The lower member is bedded upon the wall, and the joists are spiked through the vertical member. This is the usual method of building the sill; but there are other methods. Some are illustrated in Plate VII. The first figure shows a 2″ by 10″ piece bedded on the wall, and the joists running to its extreme outer edge. The first piece of sheathing applied runs entirely over the ends of the joists, past the rough floor and over the sill. This piece has the same duty to perform that the vertical plank has in the box sill construction, and it saves the expense of the extra upright planks. Upon the joists the rough floor is laid, either at right angles or diagonally, and the floor plate, or shoe, spiked to the floor even with its outer edge. The studding is toe-nailed to the plate, and the wall framing goes up to the top plate. The outside window and door openings, the second floor joists, and the main partitions are framed. The sheathing is applied, the roof framed and covered, and the outside door and window frames placed, also the outside trim. The wall covering follows—shingles, siding, stucco—whatever it may be, and the inside is lathed. The various finishing operations follow, which will be taken up later.

If the outside is to be veneered, or stuccoed to the ground line, a different form of sill is necessary. In the second figure on the Plate, the usual construction of brick veneer will be noticed. A 2″ by 6″ piece is bedded on the wall, and a 2″ by 4″ plate spiked to it. The studding is raised in the usual manner and the first floor joists are set upon a ledger board, similar to the framing of the second floor. The brick is placed, 4″ deep, upon a water table of cut stone, and tied to the sheathing with anchors of iron. The inside cellar ceiling and side walls above the foundation should be lathed and plastered —preferably with a cement plaster. If not done in this way, then the rough floor should run between the studs, headers should be placed between them, or the open spaces should be filled with brick. This precaution is necessary to act as a fire and vermin stop.

Concrete block veneer is very similar to brick, excepting that a wider foundation is necessary.

The last figure on this Plate illustrates stucco finish on "Byrkit's" patent lath. There are a number of these patent laths upon the market, some of which will be discussed in the next chapter. This particular form is known as a sheathing lath. It can be applied directly to the studding, but to do so is not the best practice.

Cornices. There is almost nothing that adds more to the appearance of a building than a well designed cornice. Not too large to look top heavy nor too small to be inconspicuous, a well planned cornice is a thing of beauty.

There are, in general, two types of cornices—the open and the box. In the open cornice, the rafter ends are visible, or false extension rafters are used over the plate. In the box cornice, the rafters are obscured from below by a horizontal plancer, or soffit. Both types of cornices suitable for frame buildings are illustrated in Plate VIII.

It will be noticed that in the first and third examples space is left between the sheathing boards, while with the second and fourth the sheathing is run solid. In the former

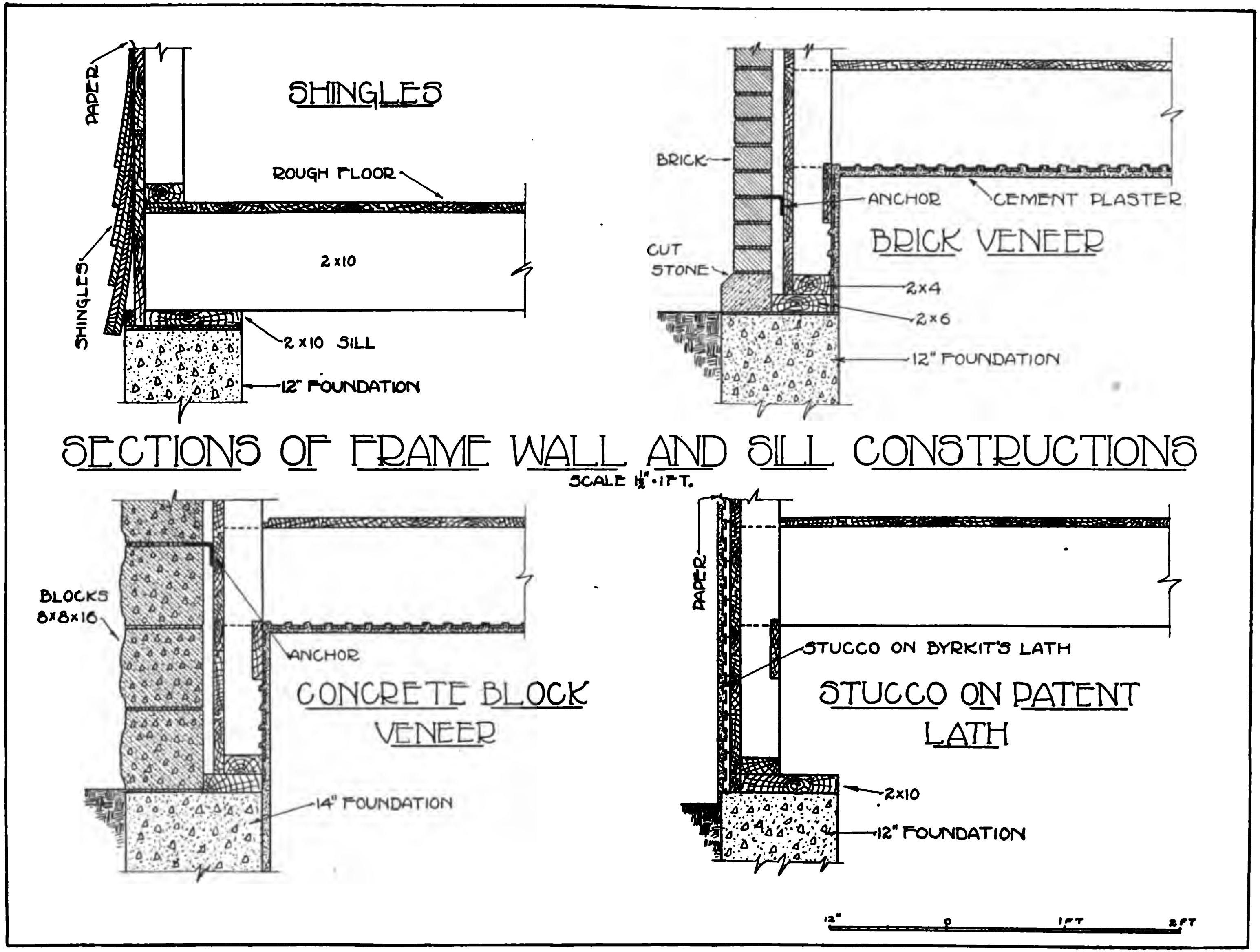

SHINGLES
PAPER
ROUGH FLOOR
2x10
SHINGLES
2x10 SILL
12" FOUNDATION
BRICK
ANCHOR
CEMENT PLASTER
BRICK VENEER
CUT STONE
2x4
2x6
12" FOUNDATION
SECTIONS OF FRAME WALL AND SILL CONSTRUCTIONS
SCALE 1½"=1FT.
BLOCKS 8x8x16
ANCHOR
CONCRETE BLOCK VENEER
14" FOUNDATION
PAPER
STUCCO ON BYRKIT'S LATH
STUCCO ON PATENT LATH
2x10
12" FOUNDATION
12" 0 1FT 2FT

PLATE VII.

case, wood shingles are used, which, beside the matter of economy, allows the roof to dry out more rapidly—hence the advantages of this method. Where clay tile are used, and other forms of roof coverings which water does not penetrate, the solid method of sheathing is adopted.

Gutters. In connection with cornices it will be necessary to speak of gutters and eaves troughs. They are usually made of or lined with tin, galvanized iron, zinc, or copper. Copper is the best, but very expensive, while tin is the most unreliable and is losing its prestige. Galvanized iron is the medium in price and grade, and is used almost entirely upon modern residences. In the first style of cornice illustrated in Plate VIII a galvanized iron eaves trough is shown in place. Notice that one end is lower than the other—this drop leading to the conductor pipe, where the water is carried to the ground. Some eaves simply hang below the edge of the shingles by means of a wire hanger, but the best run flashing under the first course, as illustrated.

There are various forms of wooden gutters lined with galvanized iron like the last example upon the Plate, and other gutters that are composed almost entirely of iron with wooden supports. The fall in these gutters is sometimes made by putting in a bottom board, high at the upper end, and tapering down to nothing at the lower. This fall need not be as great as some would suppose—3″ in 50 feet being sufficient. In gutters built upon the roof, the fall is sometimes obtained by running one end up higher than the other, but this plan usually spoils the artistic effect, the false bottom idea being much the better.

Roofing. A good roof is as essential as a good foundation, and, though other things be slighted, the durability of the roofing must be assured.

It is impossible to give a complete list of the roofing materials offered to the public, as new ones appear with each succeeding month, but a suggestive list is interesting, and follows:

Wood Shingles. Spruce, cedar, pine, cypress. Dimension and stained.

Slate. "Peach Bottom," "Brownville," "Monson," "Bangor," "Unfading Green," "Sea Green," "Variegated," "Slatington."

Tile. Interlocking, shingle, Spanish and German.

Metal Shingles. "Ohio," "Cortright," "Mullins," "Armco," "Titelock," "Unique," metal tile.

Metal Roofing in Sheets. "Target-and-Arrow," "Armco," corrugated, standing seam, V-crimp, Old Style tin, common tin.

Asphalt and Rubber in Rolls. "Elaterite," "Archinolite," "Carey," "Ruberoid," plain, flint surface, pebbled surface.

Asphalt Shingles. "Flex-a-tile," "Rex," "Hudson," "Neponset," "Vulcanite," "Jap-a-top."

Asbestos Shingles. "Century," "Transite."

Miscellaneous. "Barret Specification," common gravel.

Upon a city residence, where appearance must be considered, roll, sheet metal, and gravel roofings should not be used, as their monotonous effect is not artistic. They serve their purpose upon flat roofs, or upon barns, summer cottages, etc.

Slate and tile are expensive, the latter especially so, which fact eliminates them from the usual residence construction unless the builder cares to spend a large amount upon his roof. Asbestos shingles are also expensive, costing but a little less than slate, but lasting a great deal longer. Experience has shown that black slate will not stand up much longer than clay tile or tin shingles, while asbestos shingles, if properly laid, will stand for one hundred years or more. They are used very extensively in Germany for every class of building, and have given eminent satisfaction. Of all reasonably priced

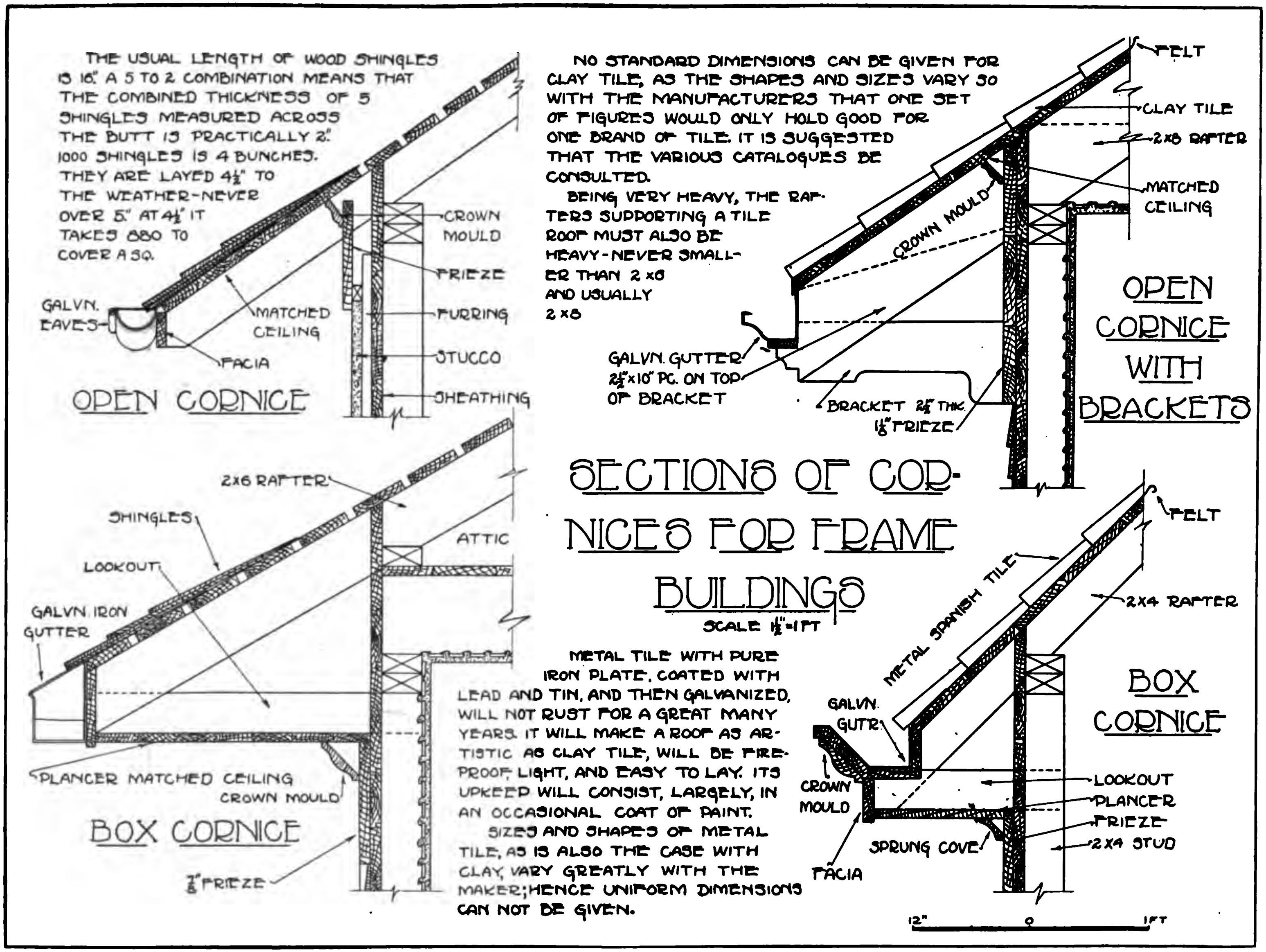

THE USUAL LENGTH OF WOOD SHINGLES IS 16." A 5 TO 2 COMBINATION MEANS THAT THE COMBINED THICKNESS OF 5 SHINGLES MEASURED ACROSS THE BUTT IS PRACTICALLY 2." 1000 SHINGLES IS 4 BUNCHES. THEY ARE LAYED 4½" TO THE WEATHER-NEVER OVER 5." AT 4½" IT TAKES 880 TO COVER A SQ.
GALVN. EAVES
MATCHED CEILING
FACIA
CROWN MOULD
FRIEZE
FURRING
STUCCO
SHEATHING
OPEN CORNICE
NO STANDARD DIMENSIONS CAN BE GIVEN FOR CLAY TILE, AS THE SHAPES AND SIZES VARY SO WITH THE MANUFACTURERS THAT ONE SET OF FIGURES WOULD ONLY HOLD GOOD FOR ONE BRAND OF TILE. IT IS SUGGESTED THAT THE VARIOUS CATALOGUES BE CONSULTED.
BEING VERY HEAVY, THE RAFTERS SUPPORTING A TILE ROOF MUST ALSO BE HEAVY-NEVER SMALLER THAN 2 x 6 AND USUALLY 2 x 8
FELT
CLAY TILE
2x8 RAFTER
MATCHED CEILING
CROWN MOULD
GALVN. GUTTER
2½"x10" PC. ON TOP OF BRACKET
BRACKET 2¼" THK.
1⅛" FRIEZE
OPEN CORNICE WITH BRACKETS
2x6 RAFTER
SHINGLES
ATTIC
LOOKOUT
GALVN. IRON GUTTER
PLANCER MATCHED CEILING
CROWN MOULD
BOX CORNICE
⅞" FRIEZE
SECTIONS OF CORNICES FOR FRAME BUILDINGS
SCALE 1½"=1 FT
METAL TILE WITH PURE IRON PLATE, COATED WITH LEAD AND TIN, AND THEN GALVANIZED, WILL NOT RUST FOR A GREAT MANY YEARS. IT WILL MAKE A ROOF AS ARTISTIC AS CLAY TILE, WILL BE FIREPROOF, LIGHT, AND EASY TO LAY. ITS UPKEEP WILL CONSIST, LARGELY, IN AN OCCASIONAL COAT OF PAINT.
SIZES AND SHAPES OF METAL TILE, AS IS ALSO THE CASE WITH CLAY, VARY GREATLY WITH THE MAKER; HENCE UNIFORM DIMENSIONS CAN NOT BE GIVEN.
FELT
METAL SPANISH TILE
2X4 RAFTER
GALVN. GUTR.
BOX CORNICE
CROWN MOULD
LOOKOUT
PLANCER
FRIEZE
2X4 STUD
SPRUNG COVE
FACIA
12" 0 1 FT

PLATE VIII.

roofing materials, the asbestos shingle is undoubtedly the most satisfactory.

Asphalt shingles come in various grades, colors, materials, and prices. Some of them will produce a perfectly satisfactory roof in point of appearance and durability, while others are not worthy of the time it takes to lay them. Be cautious in choosing one of these shingles—never accept a brand costing less than $4.00 a square, and accompanied by a reliable manufacturer's guarantee for at least fifteen years.

Wood shingles are still used upon the majority of residences of all classes and for beautiful effects at a low cost they can not be excelled. They come in various grades and materials, Washington cedar being the most common. In selecting wood shingles, their average life should be taken into consideration. The following table is comparative:

Spruce	6 years
Cedar	14 years
Pine	18 years
Cypress	45 years

These figures will vary in different parts of the country; for example, cedar shingles in dry climates have been known to stand for 20 years or more, while in damp Northern states they sometimes fail after 8 or 10 years of service. Cypress has the greatest variation. From 30 years, the lowest figure available, to 228 years, which was the length of life of cypress shingles upon a homestead in Brooklyn, N. Y. Undoubtedly, then, cypress shingles are the best wooden shingles that can be used. In this connection, it might be well to mention the fact that the kind of shingle nail used has as much to do with the life of the roofing as the material itself. Wire nails are of very little value, as they will rust out in a short time; galvanized nails are but a little better, and are not to be recommended for a lasting job; zinc nails are much better than any previously mentioned, while copper nails are very much the best. Of course they cost more than the others, but this first cost is the only cost which must be considered.

A comparative table of costs on the various kinds of roofing materials will, no doubt, prove interesting:

COMPARATIVE COSTS OF ROOFING MATERIALS

Material	Cost per Square Laid upon Roof
Wood shingles 6 to 2	$ 5.00
Wood shingles 5 to 2	5.50
Shingles dipped 6 to 2	8.00
Shingles dipped 5 to 2	8.50
Asbestos "Century" shingles	11.50
Slate (average)	12.50
Interlocking tile	18.00
Shingle tile	17.00
Spanish tile	20.00
Old style tin	11.00
Common tin	8.50
26 gauge galvanized iron	9.00
Gravel roof	4.50
Roll asphalt	3.75
Asphalt shingles	7.00
Metal shingles	8.00

Another point to consider when choosing a roofing material is the weight of same. Notice this comparative table:

WEIGHT OF VARIOUS ROOFING MATERIALS

Material	Weight per Square
Wood shingles	200 pounds
Asbestos shingles	270 pounds
Slate	800 pounds
Interlocking tile	800 pounds
Spanish tile	950 pounds
Tin	100 pounds
Galvanized iron	200 pounds
Gravel	600 pounds
Roll asphalt	100 pounds
Asphalt shingles	220 pounds
Metal shingles	100 pounds

To these weights must also be added the weight of snow and ice, and the wind load, when planning a roof. Of course these vary with the slope. Computations can be made by formula, but the following results can be accepted for the size rafters to use spaced 16″ on centers:

Pitch of Roof	Material	Size of Rafter
½ or ⅓	Wood shingles, asbestos shingles, tin, galvanized iron, roll asphalt, asphalt shingles, metal shingles	2″ x 4″ or 2″ x 6″
¼ and less	Same as above	2″ x 6″
½ or ⅓	Slate or interlocking tile	2″ x 6″
¼ and less	Slate, interlocking tile or gravel	2″ x 8″
½ or ⅓	Spanish tile, or any material weighing over 900 lbs. per sq.	2″ x 8″
¼ and less	Same	2″ x 10″

Girders. Girders are timbers supported on piers or posts that carry the middle weight upon first floor joists. There is a number of methods of fastening the joist ends to them. Plate IX illustrates three of them. At *A* is shown the iron joist hanger, which is spiked to the girder at the ends of the joists. It supports the joists and prevents them from twisting. At *B* the common method is shown. A 2″ by 2″ piece is spiked to the lower edge of the girder, and the joists are notched to receive this piece. The joists are weakened somewhat when this method is used. At *C* the joists rest upon the top edge of the girder, and are spiked together. This method necessitates setting the girder lower than the top edge of the sill, which is not necessary with the other two methods. If a solid girder is used, a 6″ by 8″ timber is strong enough; but, if built up, two 2″ by 10″ pieces or three 2″ by 8″ pieces should be used. All floor joists should be strengthened by the means of cross bridging for every eight feet of span.

Corner Post. As mentioned before in the text, corner posts in the balloon type of framing are 4″ by 4″. It is evident that they offer but one nailing surface for the lath; so it is necessary to spike square pieces to their inner faces, as illustrated in the horizontal section upon the Plate.

In Figure 18 two other methods are shown. In the first —a three member corner—two studs are fastened together with blocks spiked between, while the third is nailed to them.

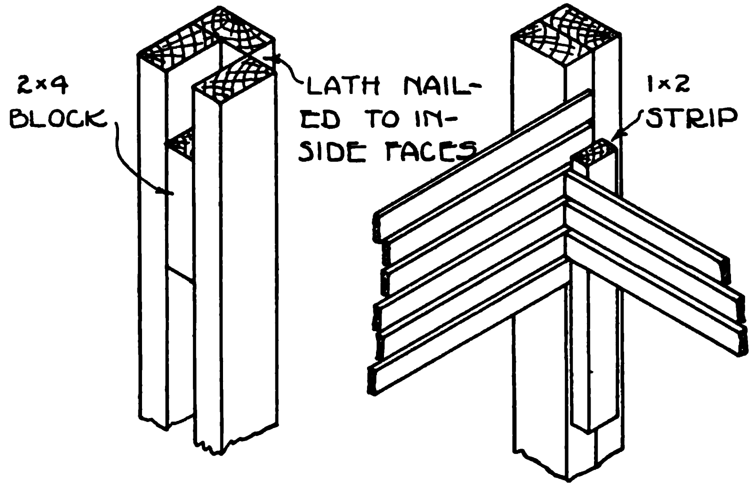
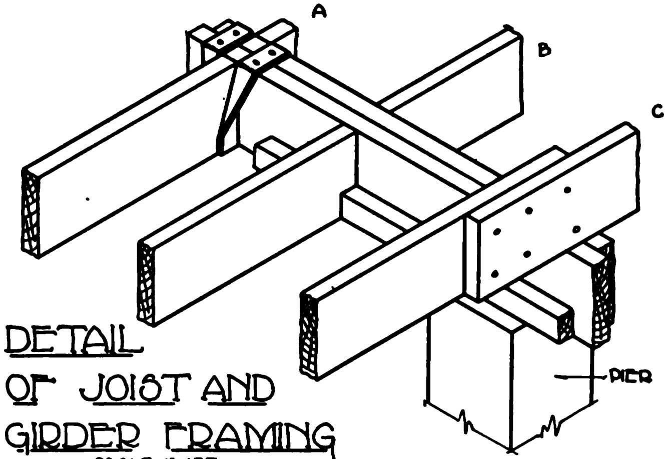


FIGURE 18.

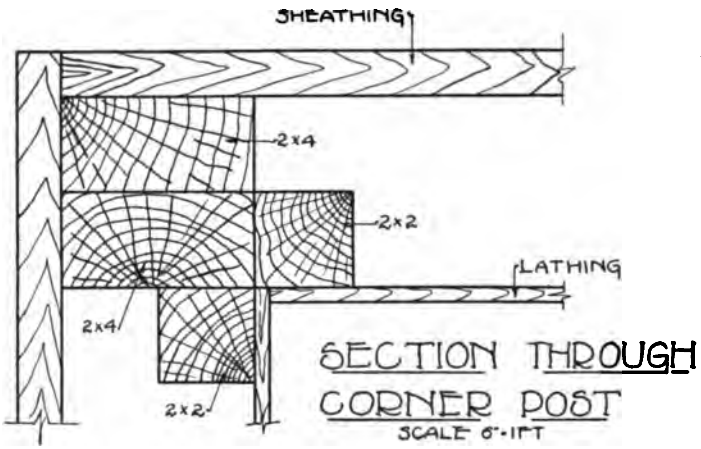
An open corner is thus formed on the inside, to which the lath may be fastened. It also produces a very strong and rigid corner. In the second method, the lath are nailed past one face of the corner, a strip spiked to the post over them, and the second series of lath nailed to this strip.

Partition Framing. Where a partition runs parallel with the floor joists, additional strength is necessary. Ordinarily the joist beneath the partition is doubled, but a better plan is to double it and separate the two pieces by the means of blocks

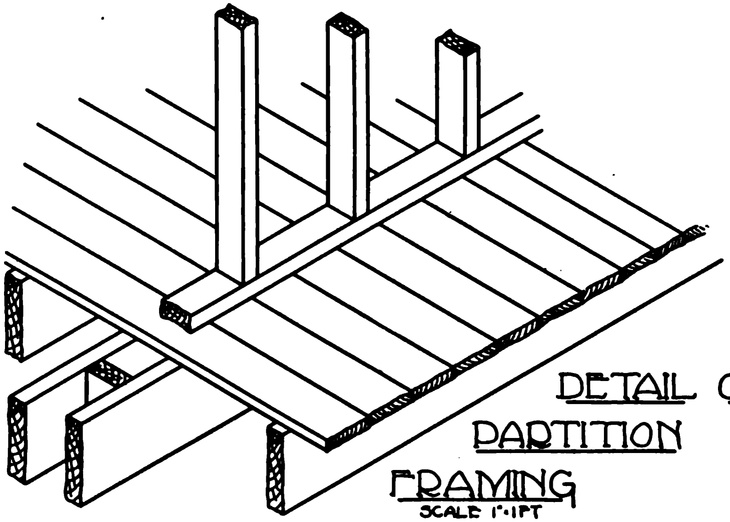
MISCELLANEOUS DETAILS



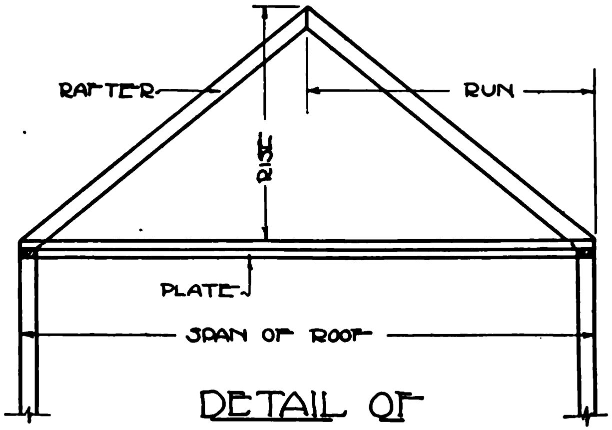
DETAIL OF JOIST AND GIRDER FRAMING
SCALE 1"=1FT



SECTION THROUGH CORNER POST
SCALE 6"=1FT



DETAIL OF PARTITION FRAMING
SCALE 1"=1FT



DETAIL OF ROOF FRAMING
SCALE ½"=1FT

spiked between them, as illustrated upon the Plate. Then if pipes, wires, etc., are run up through the partition, no weakening of the joist is effected by the cutting, as is the case when the two pieces are spiked close together.

Roof Framing. In the planning of roofs, the term "pitch" constantly recurs. A glance at the detail upon Plate IX will make its meaning clear. The *pitch* is the *slant*, or *slope*, of the roof. In the ½ pitch slope, the "rise" is equal to the "run," or ½ of the "span." In the ⅓ pitch roof, the rise is equal to ⅓ of the span; in the ¼ pitch, the rise is equal to ¼ of the span—hence it will be noticed that the smaller the pitch, the nearer flat the roof becomes. In order to find the rise when the span is known—as it will be after planning the house—decide upon the pitch wanted and divide the length of the span by this fraction. For example, if the span is 24 feet, and the ⅓ pitch roof is wanted, the rise will be ⅓ of 24, or 8 feet. If the ¼ pitch is desired, the rise will be 6 feet, and so on. To find the length of the rafters and their different cuts is quite a mathematical problem, and, as it has very little to do with the actual planning, and is entirely the business of the carpenter, it will be omitted in this text on drawing.

The different types of modern roofs are illustrated in Figure 19. The *pitch*, or *gable*, roof is the one most often employed, with the *hip* roof a close second. The former does not have the artistic possibilities of the latter, perhaps; but it takes less time to frame, and offers more attic space that can be utilized. The two types use practically the same amount of sheathing and roofing, but the pitch roof requires more siding and wall sheathing, on account of the gables. The *gambrel* roof is used largely upon barns.

Windows. The cellar window has already been discussed in Chapter IV. The usual style of two-light residence window and frame will be taken up with Plate X. There are various kinds of windows—twin, casement, cottage, gable, single sash, double hung, etc.; but the construction of all is so very similar that a good understanding of the most common—the double hung—will make the others perfectly clear. For Plate X we have chosen a two-light "Queen Anne" window in a moulded cap frame. The frame is shown in perspective in Figure 20. The plain cap is exactly like it, but for the omission of the moulding under the cap, and a smaller cap is used, as is illustrated in Figure 21. In the Plate, two views are given of

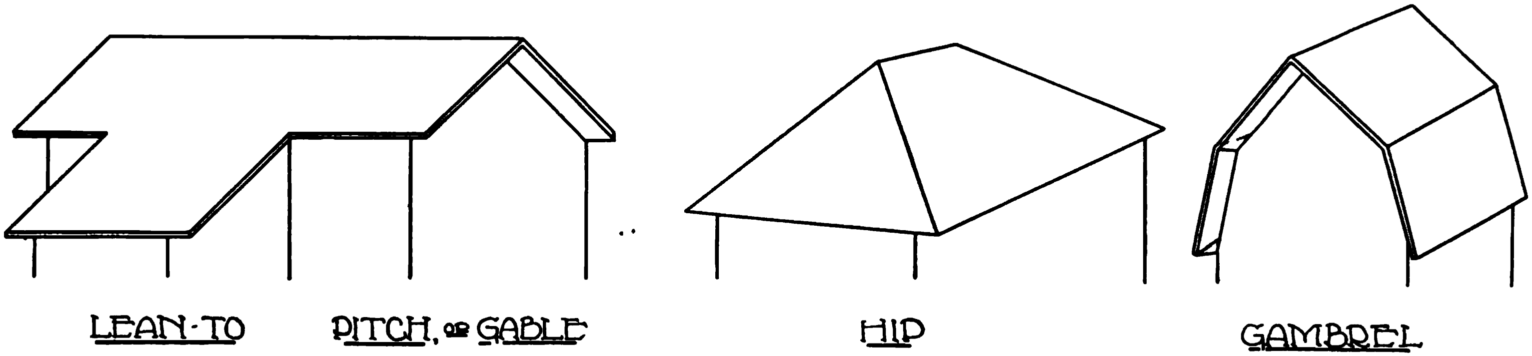


FIGURE 19.

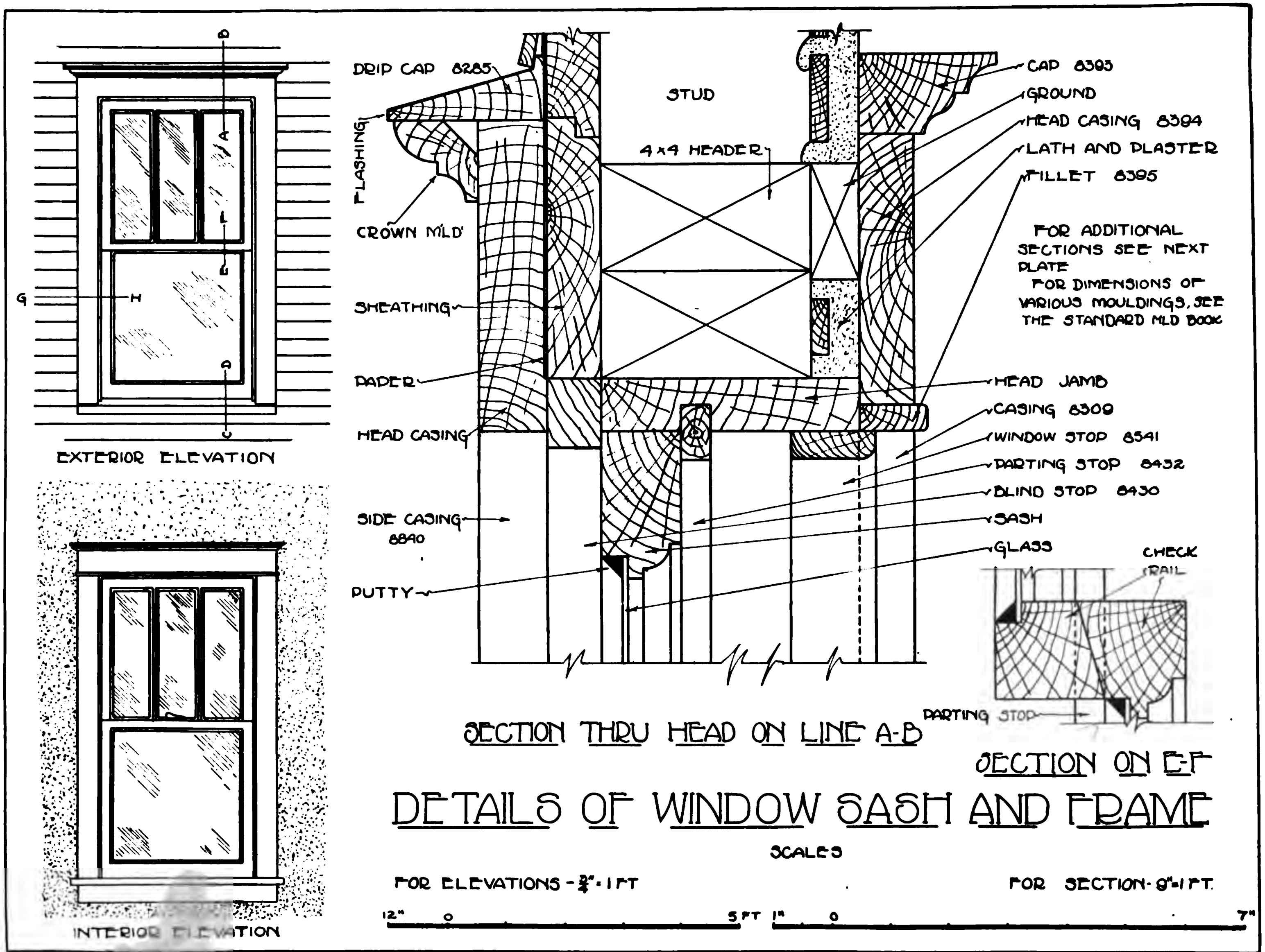

EXTERIOR ELEVATION
INTERIOR ELEVATION
DRIP CAP 8285
FLASHING
CROWN MLD'
SHEATHING
PAPER
HEAD CASING
SIDE CASING 8840
PUTTY
STUD
4x4 HEADER
CAP 8393
GROUND
HEAD CASING 8394
LATH AND PLASTER
FILLET 8395
FOR ADDITIONAL SECTIONS SEE NEXT PLATE
FOR DIMENSIONS OF VARIOUS MOULDINGS, SEE THE STANDARD MLD BOOK
HEAD JAMB
CASING 8309
WINDOW STOP 8541
PARTING STOP 8432
BLIND STOP 8430
SASH
GLASS
CHECK RAIL
PARTING STOP
SECTION THRU HEAD ON LINE A-B
SECTION ON E-F
DETAILS OF WINDOW SASH AND FRAME
SCALES
FOR ELEVATIONS - ¾" = 1 FT
FOR SECTION - 9" = 1 FT.
12" 0 5 FT
1" 0 7"

PLATE X.

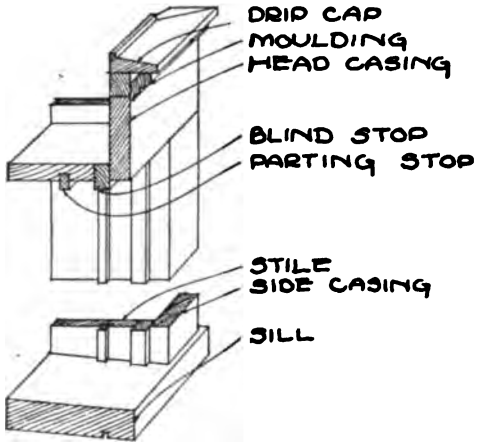


FIGURE 20.

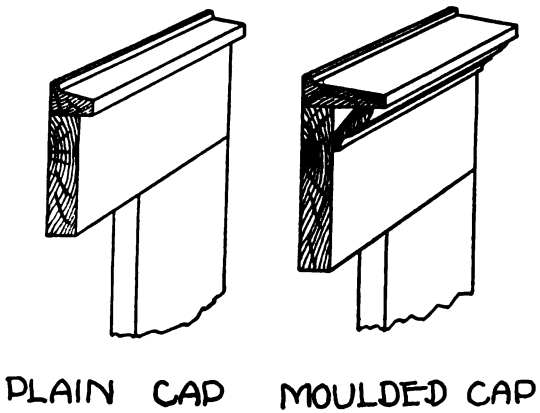


FIGURE 21.

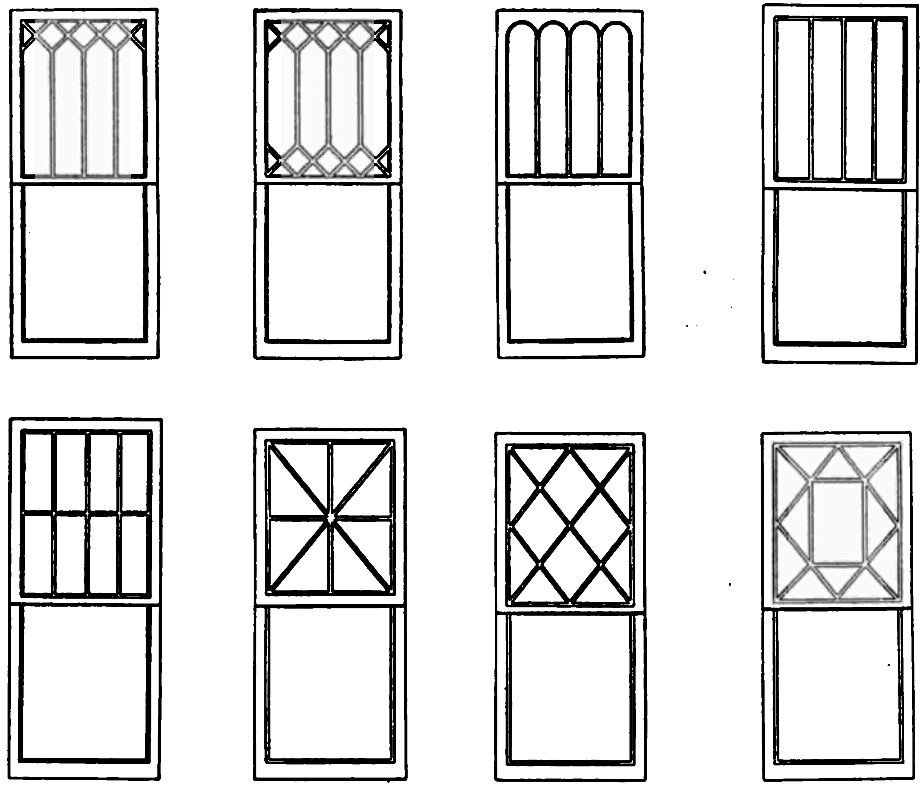


FIGURE 22.

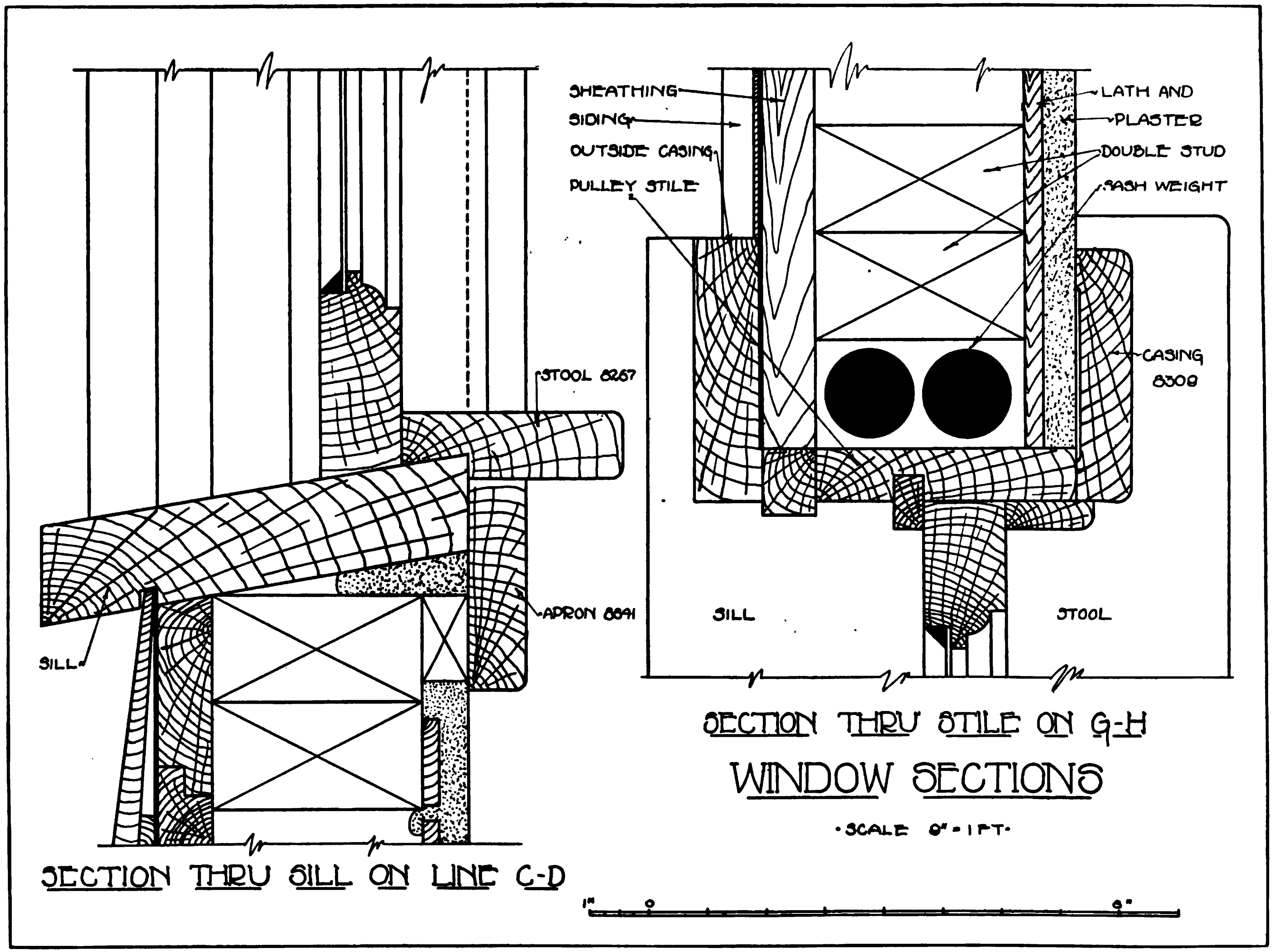

SHEATHING
SIDING
OUTSIDE CASING
PULLEY STILE
LATH AND
PLASTER
DOUBLE STUD
SASH WEIGHT
CASING
8308
STOOL 8257
APRON 8641
SILL
SILL
STOOL
SECTION THRU SILL ON LINE C-D
SECTION THRU STILE ON G-H
WINDOW SECTIONS
•SCALE 8" = 1 FT•
1"
0
8"

PLATE XI.

the finished window, one as seen from the exterior, and the other from the interior. The upper sash can be left plain, or the muntins inserted, dividing it up into smaller panes of glass. Figure 23 illustrates various other combinations of more or less artistic merit.

Upon this Plate is also shown a section through the head on line *A B*—a vertical section—and its careful study will make the construction very clear. Notice the headers—two 2″ by 4″ pieces spiked together. 2″ by 4″ is supposed to be the

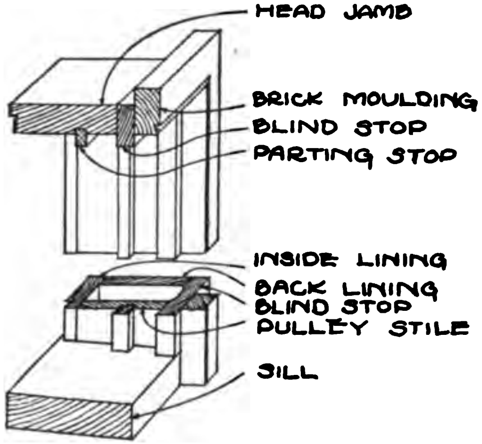


FIGURE 23.

rough size of the lumber, and after it is surfaced, that is, machine planed, it is smaller. If it is surfaced upon one side and one edge (1-S, 1-E), it will measure $1\frac{5}{8}$″ by $3\frac{5}{8}$″, if upon all four sides (S-4-S), it will measure $1\frac{1}{2}$″ by $3\frac{1}{2}$″. Hence window frames as they come from the mill have jambs that are usually $5\frac{3}{8}$″ wide, allowing about $1\frac{3}{4}$″ for the thickness of the sheathing on the outside, and the lath and plaster on the inside. A "ground" the thickness of the lath and plaster is nailed on the inside, to which the head casing can be fastened. The outside casing, as Figure 21 shows, is nailed to the jamb as it comes from the mill; but the inside trim, which offers a great variety in design, is built on after the plastering is completed. Upon this Plate will also be noticed a section through the check rail, showing its construction.

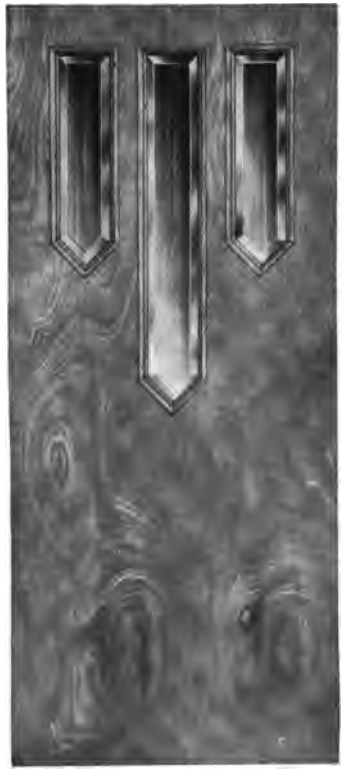


FIGURE 24.

FIGURE 25.

Plate XI illustrates other sections taken through the same window. The first is a vertical section through the sill, showing all its details at this point, and the second, a horizontal

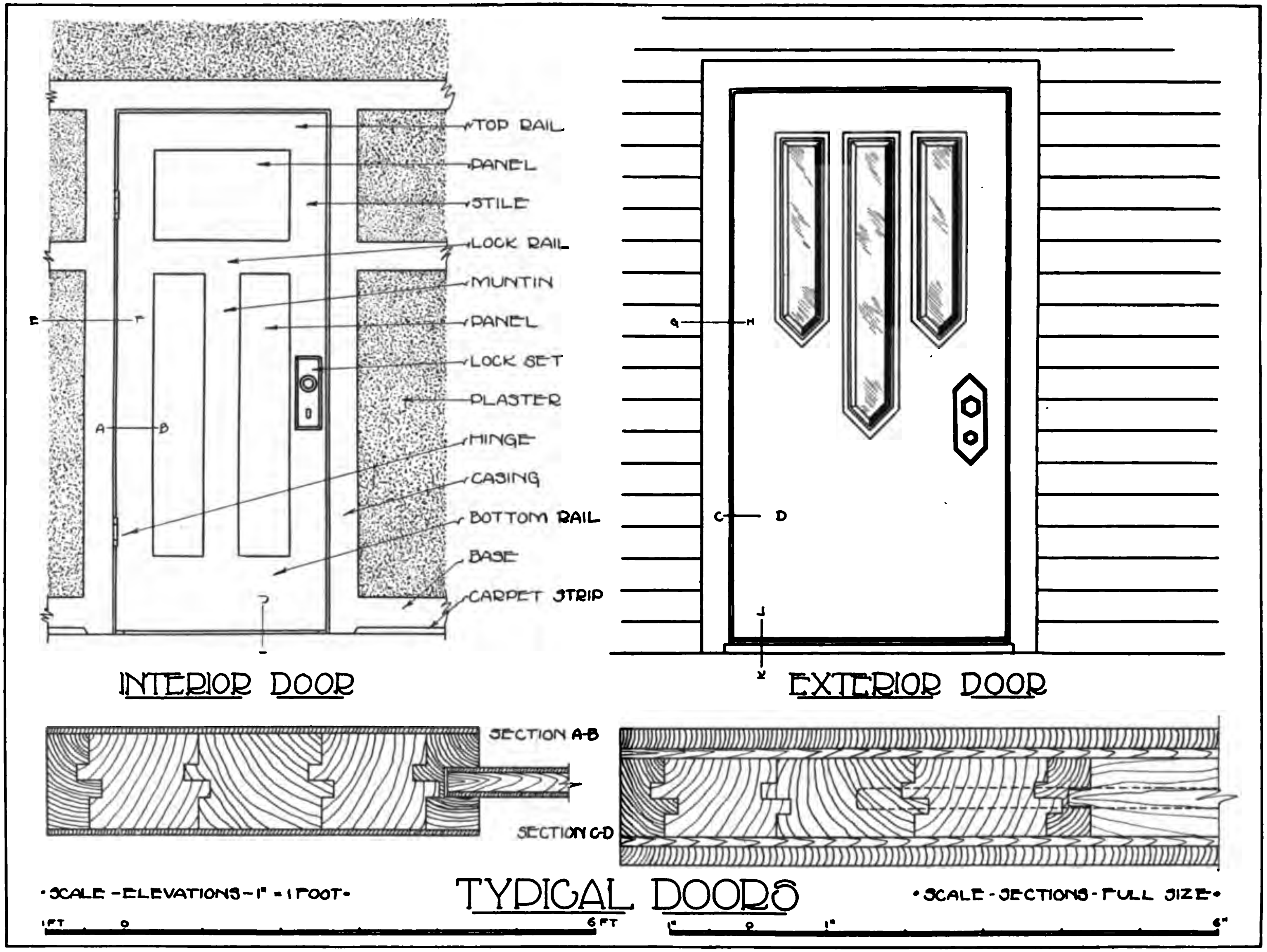

TOP RAIL
PANEL
STILE
LOCK RAIL
MUNTIN
PANEL
LOCK SET
PLASTER
HINGE
CASING
BOTTOM RAIL
BASE
CARPET STRIP
INTERIOR DOOR
EXTERIOR DOOR
SECTION A-B
SECTION C-D
TYPICAL DOORS
• SCALE - ELEVATIONS - 1" = 1 FOOT •
• SCALE - SECTIONS - FULL SIZE •
1 FT 0 6 FT
1" 0 1" 6"

PLATE XII.

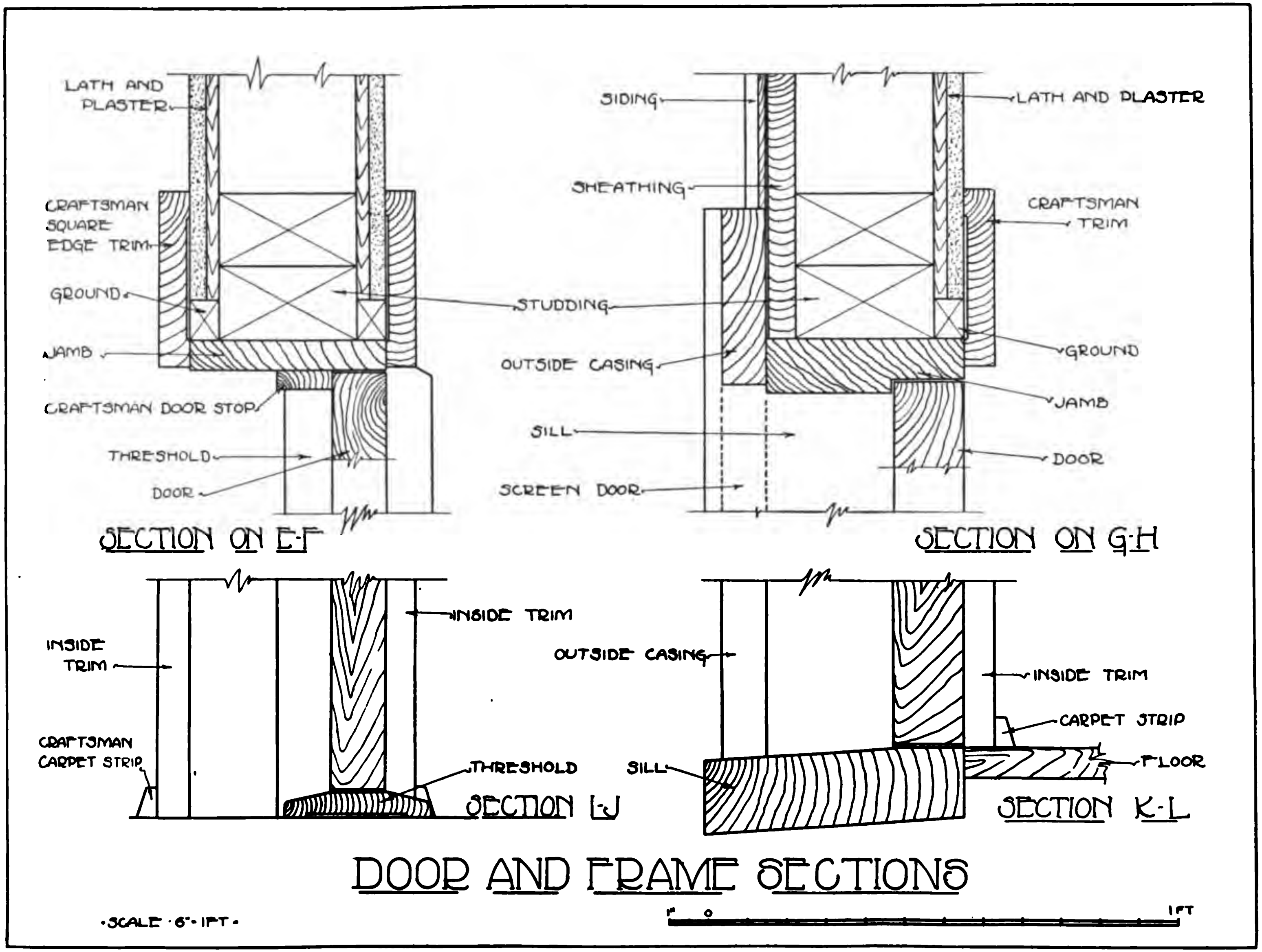

LATH AND PLASTER
CRAFTSMAN SQUARE EDGE TRIM
GROUND
JAMB
CRAFTSMAN DOOR STOP
THRESHOLD
DOOR
STUDDING
SIDING
SHEATHING
LATH AND PLASTER
CRAFTSMAN TRIM
OUTSIDE CASING
GROUND
JAMB
SILL
DOOR
SCREEN DOOR
SECTION ON E-F
SECTION ON G-H
INSIDE TRIM
INSIDE TRIM
CRAFTSMAN CARPET STRIP
THRESHOLD
SECTION I-J
OUTSIDE CASING
INSIDE TRIM
CARPET STRIP
SILL
FLOOR
SECTION K-L
DOOR AND FRAME SECTIONS
·SCALE · 6" = 1 FT ·
0
1 FT

PLATE XIII.

section through the stile, illustrating the pocket left between the studding and the stile for the sash weights. These weights are usually of cast-iron 1½″ or 1⅝″ in diameter. They are sold by weight; one weighing one half as much as the single sash that it balances, and four being required for each window. There should be a pocket cut in each stile for the removal of the sash weights when necessary.

Window frames for brick buildings have a brick moulding upon the outside in place of the casing, and a framed pocket for the weights, as Figure 23 shows; otherwise their construction is almost identical with those for the frame building.

Doors. Doors possess an artistic possibility that few realize. From the outside hardly any part of the building is more noticeable, and a well chosen door that fits into the style of architecture as it should always excites admiration. An artistic door is never an elaborate one. The plain door with dignified ornaments and hardware is much more to be desired than one covered with carvings and scrolls, with an etched landscape upon a glass panel. For plain, sensible effects, the new sanitary flush door is undoubtedly the best. It does not collect dust and dirt, and its extreme simplicity is beauty in itself. Figure 24 illustrates a "Morgan" door of this style, while other manufacturers offer a similar variety of this kind.

The same air of simplicity should guide one in the choice of an interior door. Notice how the panels in the door illustrated follow into the plain "Craftsman" trim. Figure 25 is from a photograph of this same door.

The cross-sections showing the methods of building these two doors are interesting. It will be noticed that the first, a section through the stile, is glued up of small matched strips of softwood, with hardwood upon the edges that show. Over this core is placed the veneer upon each side. The panel is also veneered upon both sides; hence, if two adjoining rooms have different woods for trim, the two sides of the door can be veneered accordingly.

The sanitary flush door has a core similar to the other, but no panels. The rails are doweled to the stiles and to each other, thus building up a door of innumerable pieces all held together with dowel pins and glue. Over this core is placed a cross veneer, and thereon the thicker veneer of the finished wood; thus securing a door that can not shrink or warp.

Plate XIII illustrates the various cross-sections. The section on line *E-F* is a horizontal section of the interior door-frame, showing, also, the plain "Craftsman" trim. *I-J* is a vertical section through the threshold, *G-H* a horizontal section through the exterior door-frame, and *K-L* a vertical section of same. Sometimes a hardwood threshold is used over the sill of the outside door, in a manner similar to the interior, which is a very good practice, as it effectively conceals the joining of the frame sill and the floor.

Instructions for Drawing Plates VII, VIII, IX, X, XI, XII, and XIII

Margins same as Plate I.

Plates VII and VIII. These Plates are to be drawn to the scale of 1½″ equals 1 foot, and practically all the necessary dimensions are given upon them. Those students that need more can find them by scaling.

Plate IX. The two isometrics are to be drawn 1″ to the foot, the horizontal section one half full size, and the roof problem ½″ to the foot. As there are three different scales represented, it was not convenient to put the graphic scales upon the drawing; hence more detailed dimensions will be necessary. The girder in the first figure is composed of two 2″ by 10″ pieces. The joists are 2″ by 10″ spaced 16″ on centers. The supporting strip is 2″ by 2″, and the pier is 12″ square. In the section all dimensions are given. The par-

tition detail has 2″ by 10″ joists, 2″ by 4″ plate and studs. The space between the double joist is 4″. In the roof framing detail all members are 2″ by 4″. The span of the roof is 12′ and the rise is 5′, making a rather uncommon pitch number.

Plates X and XI. The elevations are drawn to the scale of 3/4″ equals 1 foot, and the details are three fourths full size, or 9″ to the foot. The headers are drawn to the scale of their finished size, that is, 1 5/8″ by 3 5/8″, as the window jamb and stiles are but 5 3/8″ wide.

Plates XII and XIII. The door elevations are drawn 1″ to the foot, and their sections full size. The frame sections are drawn one half full size, or 6″ to the foot. The interior door is 1 3/8″ thick, 2′ 8″ wide, and 6′ 8″ high, and the exterior is 1 3/4″ thick, 3′ 6″ wide, and 7′ 0″ high. The scale will give all other necessary dimensions. The door knobs are from 2′ 6″ to 3′ from the floor.

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L. M. Roehl—"Problems in Carpentry."
Wm. Arthur—"New Building Estimator."

CHAPTER VII

WALL COVERING

A few of the wall coverings were mentioned in the last chapter; but, as their construction was not taken up in detail, and as they form a subject of such great importance, a separate chapter must be devoted to them.

Coverings for frame walls are divided into two groups—exterior and interior. In the exterior group may be placed the following: sheathing with siding, rough boards, shingles, brick veneer, cement block veneer, stucco on wood lath, stucco on metal lath, stucco on patent lath, and stucco on patent sheathing. In the interior group: plaster on wood lath, plaster on metal lath, plaster on patent lath, plaster board, and wall board.

The construction of siding, shingles, cement block and brick veneer have already been illustrated; hence little space will be given them here.

Lath and Plaster. In the first figure in Plate XIV, we have a section of ceiling lath and plaster. The lath are spaced $\frac{3}{8}''$ apart in order to form a large, strong key to hold the plaster to the ceiling. A modern tendency is to place them closer together, as a saving in plaster will be thus effected; but it is a bad practice and should be condemned. Figure 26 illustrates the formation of the key on the side wall. It also shows lath that have been placed too close together, allowing no plaster to come through in some places, and forming a long, thin key in others. A violent jar would crack this long key at the bend, and the plaster on the reverse side would probably fall in a short time.

Plaster should be applied in three coats, but the modern tendency is to put it on wood lath in two. The lime is slaked, that is, covered with water and allowed to stand for at least eight days, when hair and sand are added, bringing it to the proper consistency. If the hair is put in before the lime is thoroughly slaked, it is liable to burn and lose its strength.

The first coat, in two coat work, is put on and pushed well into the lath so as to form the key, and brought out very near the surface of the grounds. When it has hardened perfectly, a scrim coat of plaster of Paris hard finish is applied, which, completes the operation. In three coat work, the first coat is put on about $\frac{1}{4}''$ thick, scratched almost down to the lath, and allowed to harden before the second coat, or brown coat as it is sometimes called, is applied. The third coat is put on as in the former method.

Metal Lath. There is a large number of metal laths upon the market, some of which are excellent—others almost worthless. The former have undoubtedly lost a great deal of prestige through the failure of the latter, which is to be regretted, as a good metal lath is much better than wood lath. Expanded metal lath is made of sheet steel, cold punched, usually, and "expanded" by being wrenched or pushed into open meshes, large or small, as the cuts are made longer or shorter. If "self-furring," the lath is made "wavy," so that ridges touch the support allowing space for the plaster to get back of the lath to form a key. If not, then furring strips, usually wood lath, must be nailed over the sheathing and paper, at regular intervals, and the metal lath stapled to them. Of the two kinds of metal laths, the self-furring is undoubtedly the best, as a stronger support is secured.

Being made of steel, metal lath, unless protected, will surely rust. The protection is usually galvanizing or painting. The thickness of expanded metal runs from 27 gauge, being the lightest, through 26 gauge, 25 gauge, and 24 gauge, the latter being the heaviest. The 27 gauge is not recommended

for any use, as it is too light. 26 gauge may be used for inside work, to support a Portland cement plaster, and either 25 or 24 gauge for outside stucco. The lath is usually fastened in place with 1¼" staples, made from 14 gauge wire. It is shipped in sheets 18" by 96", packed in bundles of 15 sheets, which will cover 20 square yards with studding spaced 16" on centers.

Another form of metal lath is the woven wire, a brand of which is illustrated upon the Plate. This is known as a trussed wire lath, and is much stiffer and stronger than the woven wire cloth. It has an advantage over the expanded metal in that "the fabric is completely embedded in the mortar, and thus secured from the corrosive action of the atmosphere; and also to the fact that rust will not attack the smooth round wire as it does the thin cut edges of a metal fabric," as the catalogue states.

The third form of metal lathing is the sheet metal lath, in which loops are punched out of the steel at regular intervals, but without expanding the whole body of the steel. This kind, of which the "Bostwick" is an example, requires less plaster than the other forms.

Patent Lathing and Boards. There is a number of patent laths upon the market, made of wood in various shapes, and in combination with other materials. One of these, the "Byrkit" sheathing lath, was mentioned in Chapter VI. It comes in matched boards from 4 to 16 feet in length, ⅞" thick, and either 4" or 6" wide. It has a dovetail face into which the stucco forms its key, and is nailed directly to the studding, thereby serving as sheathing as well as lath. Some builders that use it prefer to put it over sheathing and building paper, thereby adding warmth to the structure. Another typical form of patent lath is illustrated upon the Plate of this lesson—the "Bishopric Stucco or Plaster Board." It is formed, as the vertical section shows, of dovetailed lath, bedded in "Asphalt Mastic," and backed by a piece of heavy cardboard. This is nailed directly to the studding and the key is formed between the lath. If used on the outside for stucco, the lath are dipped in creosote; if for inside plaster, they are left clear. If a 6d galvanized nail is driven through each lath into each stud, thus holding it very securely to the wall, it will form a very strong surface. It is shipped in rolls containing 100 square feet, and is 4 feet wide and 25 feet long. As in the case with the "Byrkit" lath, some builders will use this board over regular sheathing.

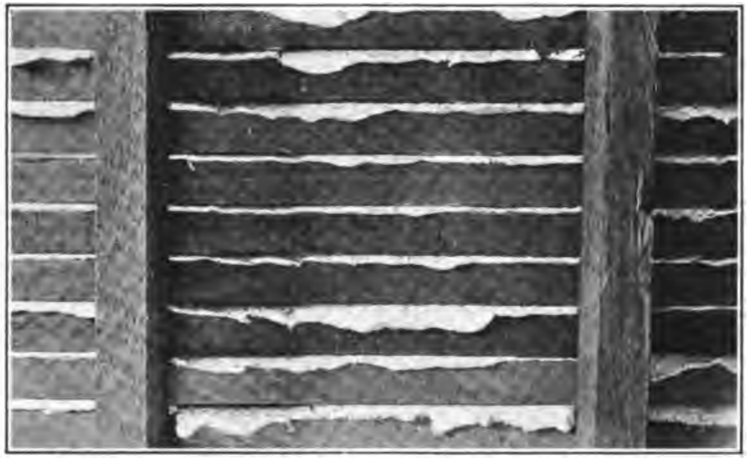
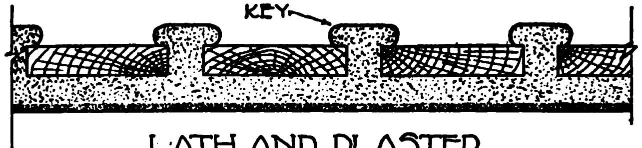


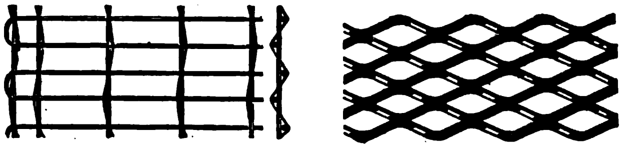
FIGURE 26.

Cement Stucco. Interior lime plaster has already been described as it is used upon wood lath. If metal lath are employed, the first coat for inside work should consist of one part Portland cement, three parts of clean sand, and enough hair to give the plaster the necessary fibre. The wall is finished with the usual white coat. A cement plaster of this kind will not rust out the lath as a lime plaster is liable to do.



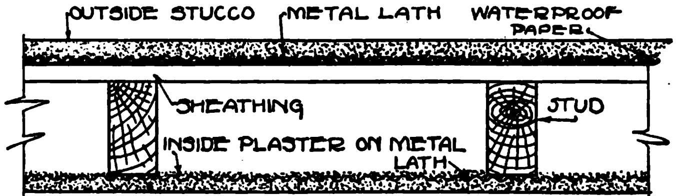
LATH AND PLASTER

WOOD LATH ARE 3/8" THICK, 1 1/2" WIDE, AND 32" OR 48" LONG. THEY ARE SPACED ABOUT 3/8" APART. IF 32" LATH ARE USED, IT WILL REQUIRE 2,200 FOR 100 YRDS. IF 48" - 1500. THERE ARE 50 LATH IN A BUNDLE. PLASTER IS PUT ON IN THREE COATS - FIRST, BROWN, AND FINISH.



GREENING'S WIRE **METAL LATH** EXPANDED

A GOOD METAL LATH IS BETTER THAN WOOD, AS IT FORMS A STRONGER KEY AND IS NEARER FIRE PROOF. BUT ITS COST IS AGAINST IT, AS IT IS ABOUT TWICE AS EXPENSIVE - LAYED UPON THE WALL - AS WOOD LATH.



SECTION THRU' WALL USING METAL LATH

HORIZONTAL SECTION

THE ABOVE SECTION, TAKEN THROUGH AN OUTSIDE WALL, SHOWS CEMENT STUCCO ON THE OUTSIDE, AND LIME PLASTER ON THE INSIDE SURFACE, BOTH SUPPORTED ON SELF-FURRING EXPANDED METAL LATH.

WALL BOARDS

USUAL CHARACTER

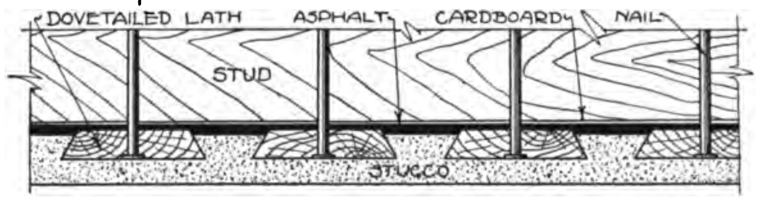
THE ABOVE SECTION SHOWS THE CONSTRUCTION OF THE MAJORITY OF WALL BOARDS - A NUMBER OF LAYERS OF WOOD PULP CARDBOARD CEMENTED TOGETHER WITH LAYERS OF ASPHALT, THE WHOLE BEING ABOUT 3/16" THICK.

"COMPO-BOARD"

"COMPO-BOARD" - A TRADE NAME - IS CONSTRUCTED OF VARIOUS SMALL STRIPS OF WOOD, CEMENTED TOGETHER BETWEEN TWO SHEETS OF HEAVY PAPER. THE LARGE NUMBER OF STRIPS PREVENT WARPING. 3/16" THICK

PLASTER BOARD

THERE IS A NUMBER OF BRANDS OF PLASTER BOARD UPON THE MARKET OF VERY SIMILAR CONSTRUCTION - A THICK COAT OF GYPSUM PLASTER BETWEEN TWO SHEETS OF CARDBOARD. THIS PRODUCT IS NOT EFFECTED BY WEATHER CHANGES AS MUCH AS THE OTHER KINDS OF BOARDS



"BISHOPRIC" STUCCO OR PLASTER BOARD

VERTICAL SECTION

"BISHOPRIC" BOARD IS NOTHING LIKE THE PLASTER BOARD MENTIONED ABOVE, AS IT IS MERELY A SUBSTITUTE FOR LATH AND SHEATHING OVER WHICH STUCCO OR PLASTER IS APPLIED

SCALE - ABOVE HORIZONTAL SECTION - 3 INCHES = 1 FOOT

WALL COVERINGS

SCALE - FOR ALL OTHER FIGURES - FULL SIZE -

PLATE XIV.

For outside stucco work, the first coat should contain two and one half parts of sand to one part of Portland cement, pushed well into the lath. For the second coat the same proportions are used, and for the third coat two parts of sand to one part of Portland cement. Each coat must be roughened up and dry before the next is applied, and, when completed, the three coats must have a thickness of ¾".

The outside may be finished in any of the following methods: *Smooth troweled*, that is, finished smooth with a metal trowel; *stippled*—the smooth troweled finish lightly patted with a brush of broom straw to give an even, stippled effect; *sand floated*—the finished surface is rubbed with a circular motion when partially set, with a wood float and a little dry sand; *sand sprayed*—the finished surface is sprayed, when still moist, with a long fibre whisk broom, with a creamy mixture of equal parts of cement and sand, by throwing the mixture forcibly against the surface; *spatter dash*, or *rough cast*—a mixture of two parts sand to one part of cement is thrown against the moist finish coat, so as to give the wall a uniform rough surface when viewed from a distance of 20 feet; *pebble dash*—small round pebbles or other material are thrown into the moist finish coat and pushed in with a clean wood trowel; *exposed aggregates*—the finishing coat is composed of Portland cement with coarse sand, marble chips, granite dust, or any other material. Within 24 hours after being applied and troweled smooth, it is scrubbed with a stiff brush and water, thereby exposing the aggregates.

Wall Board. Wall board is an inside substitute for lath and plaster. It has a large number of advantages over the latter—and a few disadvantages. In the first place, it can be applied during any kind of weather, and no time need be lost in waiting for plaster to dry out. It can be applied by a carpenter or almost anyone that can hammer and saw; it is clean and makes ideal material for repairing and remodeling; some brands are waterproof and reasonably fireproof; the surface may be painted, papered, or decorated in any other way, or it can be purchased in imitation of different finished woods for paneling. Catalogues of the numerous manufacturers will list various other advantages peculiar to their own product. Its disadvantages are few, and are undoubtedly more than offset by its advantages. Some brands will warp in damp weather, resulting in a bulging between the studding; if papered over nail heads, the latter are liable to rust

FIGURE 27.

and show through the paper; when the house is heated some boards will shrink and break the paper at the joints; some of the cheaper boards are so thin that a jam will break through them. But these disadvantages will decrease if a reliable brand is chosen, and the cracks covered with panel strips.

In Plate XV is illustrated the method of drawing the walls of a room to be covered with wall board. We have selected the dining room of the residence whose working drawings appear later on. In the center will be noticed the ceiling, which

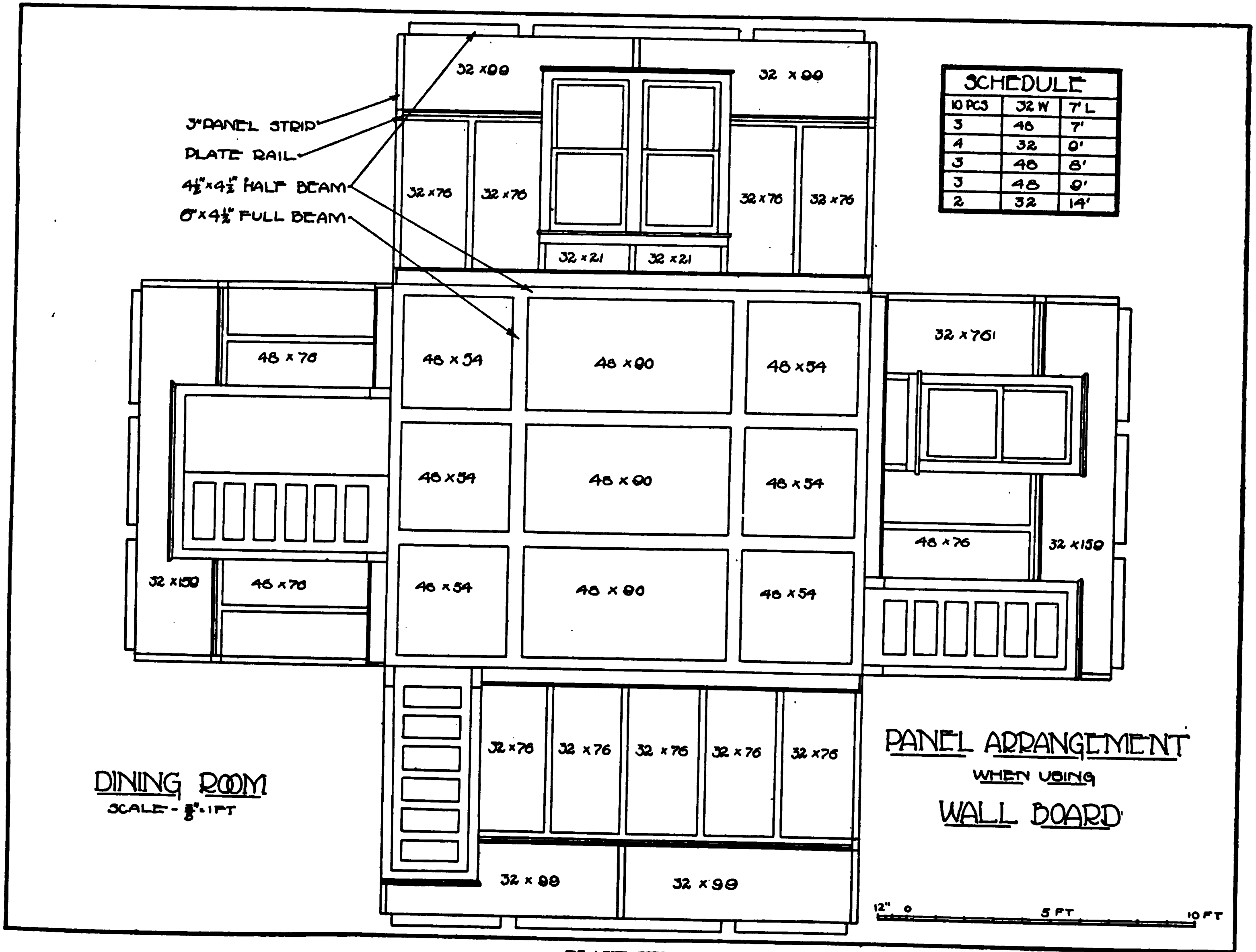

3" PANEL STRIP
PLATE RAIL
4½"×4½" HALF BEAM
6"×4½" FULL BEAM
32 × 99
32 × 99
32 × 76
32 × 76
32 × 76
32 × 76
32 × 21
32 × 21
SCHEDULE
10 PCS | 32 W | 7' L
3 | 48 | 7'
4 | 32 | 9'
3 | 48 | 8'
3 | 48 | 9'
2 | 32 | 14'
48 × 76
48 × 54
48 × 90
48 × 54
32 × 761
48 × 54
48 × 90
48 × 54
48 × 76
32 × 159
32 × 159
48 × 76
48 × 54
48 × 90
48 × 54
32 × 76
32 × 76
32 × 76
32 × 76
32 × 76
32 × 99
32 × 99
DINING ROOM
SCALE - 3/8" = 1 FT
PANEL ARRANGEMENT
WHEN USING
WALL BOARD
12" 0 5 FT 10 FT

PLATE XV.

is beamed, and on each side of it are the walls in their proper location to each other. Imagine the ceiling to be the floor, and the walls to be bent up at right angles, forming a little box, and the inside of the room can be vividly pictured.

Figure 27 illustrates a bedroom finished with "Beaver Board," decorated with stencils, and paneled with enameled strips, making a very charming room.

The wall board of most manufacturers comes in widths of either 32" or 48", as studding is placed 16" on centers. Over each crack should be placed a panel strip, the plate rail, or the ceiling beam, to hide the crack. In lengths, wall board comes 7, 8, 9, 10, 12, 14, and 16 feet, and must be so figured when planning the arrangement of a room.

Another form of wall board known as "plaster board" is making headway in the trade. As the drawing shows, it is composed of a layer of gypsum plaster between two sheets of cardboard. It can be nailed to the studding, and it will not shrink or swell with changes in the weather. A thin plaster coat can be put upon it, thereby obtaining a white plaster wall without the time and expense necessitated with the regular method.

Comparative Costs. The following table of costs may be taken as comparative, only, as the figures on the various materials change very rapidly with changes in the market:

COMPARATIVE COST OF WALL COVERING MATERIALS*

Material	Cost per Square on Wall
4" clear siding	$4.00
Wooden shingles	6.50
Stucco on wood lath	5.50
Stucco on expanded metal lath	8.80
2-coat plaster on wood lath	3.20
3-coat plaster on wood lath	3.60
3-coat plaster on metal lath	6.40
Wall board—cheapest	3.25
Wall board—most expensive	4.50

*Cost of sheathing is not included.

Instructions for Drawing Plates XIV and XV

Margins same as Plate I.

All the figures on Plate XIV are drawn full size excepting the "Section Through Wall Using Metal Lath," which is drawn 3" to the foot. A study of samples of metal lath and wall boards will make their construction very clear.

It is advisable to omit the drawing of Plate XV until an original residence has been planned, when a room in same can be worked out in a manner similar to the plate.

REFERENCES

There is very little material in book form dealing with wall coverings, especially metal lath and wall boards; hence the various trade catalogues must be referred to for complete discussions.

CHAPTER VIII

STAIRS

Stairs form a very important feature of a building, and great care should be exercised in designing them. Upon their attractiveness largely depends the impression that the whole house will leave with a visitor. They must not be looked upon as a separate and unrelated piece of furniture, embellished with carvings and useless ornaments, but must bear a distinct relation to the interior trim. A fancy staircase certainly does not go well with plain "Craftsman" trim, and the reverse is also true.

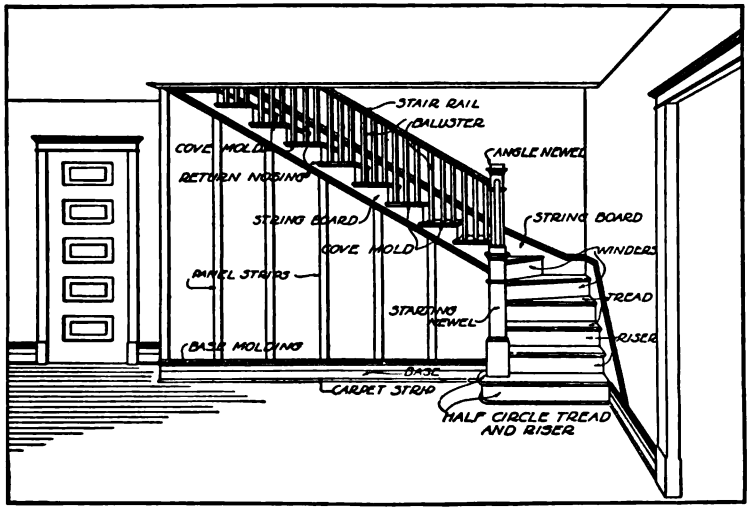


FIGURE 28.

Experienced architects, designing a home for the wealthy, will draw up a distinctive staircase for that individual building; but, when expense is an item to keep down, they will specify a stock stair of some good millwork company. Catalogues will show a great variety of such stock designs, suitable for any scheme of interior decoration, and sold at a reasonable price on account of their being made up in quantities, whereas a single stair will necessitate so much individual work that its cost prohibits it from the average home.

Definitions. In Figure 28 we have illustrated a staircase of simple design, and designated its various parts. A study of it and Plate XVI will make its definitions clear. The *staircase* is the complete stair. The *stairway* is the space taken up by the staircase. The *stair well* is the opening in the upper floor through which a person passes in ascending the stairs. The *rise* is the vertical height of the stairs, measured from the top of the lower floor to the top of the upper. The *run* is the horizontal length over the floor that the stairs will occupy. The *pitch* is the angle of inclination of the stairs. The hori-

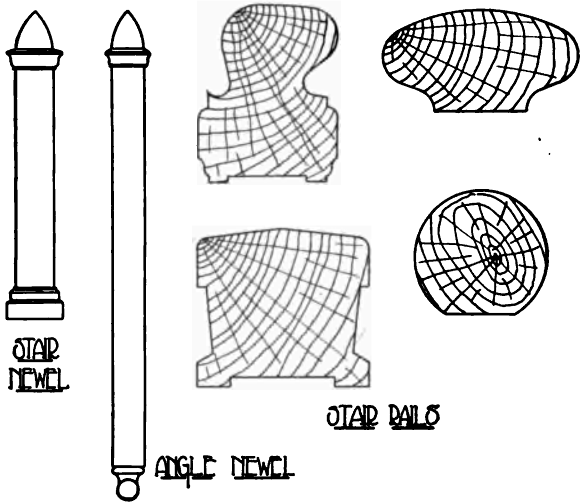


FIGURE 29.

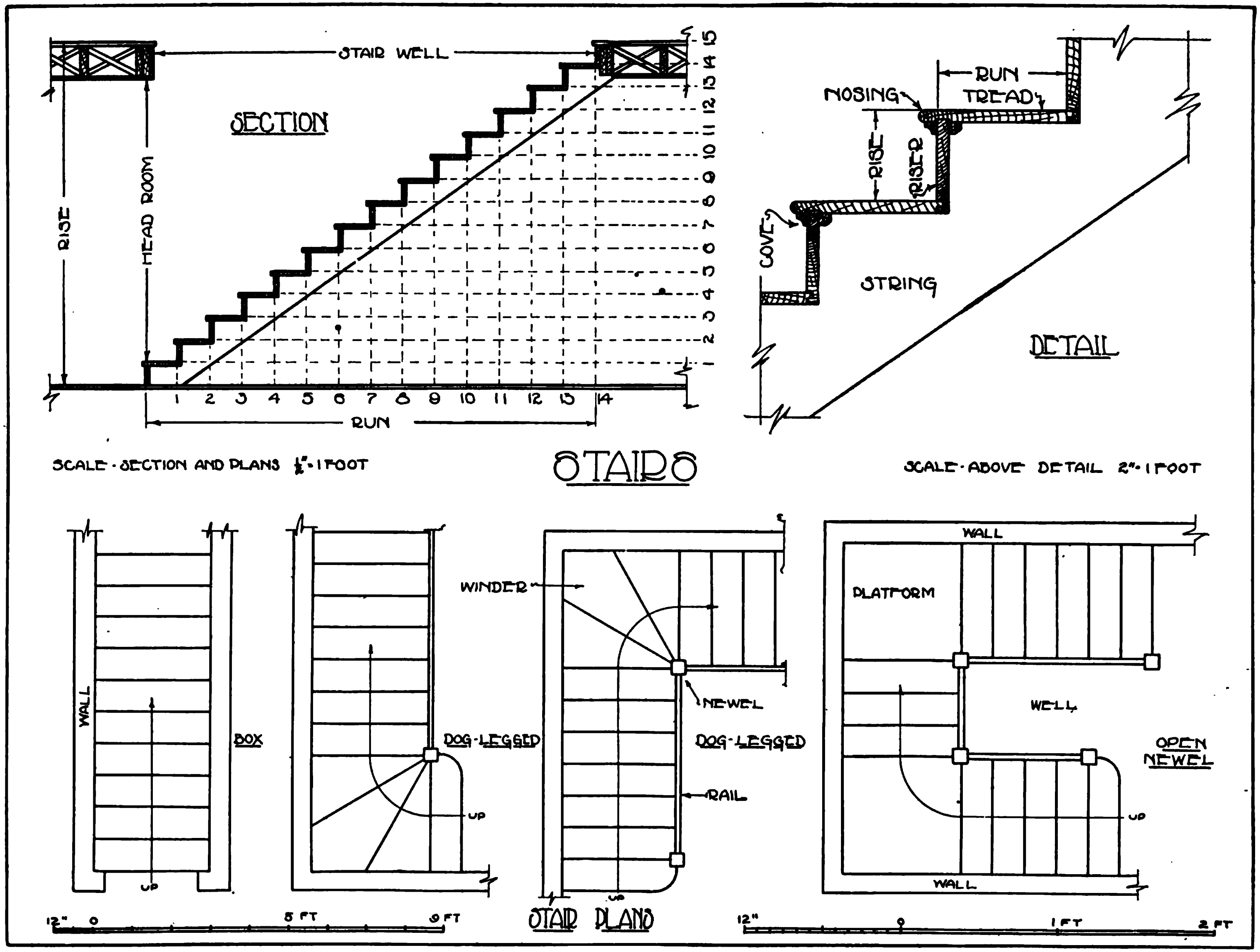

STAIR WELL
SECTION
RISE
HEAD ROOM
RUN
1 2 3 4 5 6 7 8 9 10 11 12 13 14
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
NOSING
RUN
TREAD
RISE
RISER
COVE
STRING
DETAIL
SCALE - SECTION AND PLANS 1/8" - 1 FOOT
STAIRS
SCALE - ABOVE DETAIL 2" - 1 FOOT
WALL
BOX
UP
DOG-LEGGED
WINDER
NEWEL
DOG-LEGGED
RAIL
WALL
PLATFORM
WELL
OPEN NEWEL
WALL
12" 0 5 FT 10 FT
STAIR PLANS
12" 0 1 FT 2 FT

PLATE XVI.

zontal surface of each step is called the *tread*, and the vertical surface is the *riser*. The *rise* of each step is the vertical height from the upper face of one step to the upper face of the next. The *run* of each step is the horizontal distance from the front face of one riser to the front face of the next. Do not confuse these with the *rise* and *run* of the *staircase*. The *string board* is the board forming the side of the staircase and supporting the ends of the steps. A *stair rail* is placed at the outer edge of the stairs to assist in climbing and as a matter of safety. It is supported by spindle-like *balusters*, which are mortised into each tread. *Newels* are posts placed at the ends and turns to which the rails run. They also help to support the strings. A starting newel, an angle newel, and sections of common stair rails are illustrated in Figure 29.

Types of Stairs. Plate XVI also illustrates various types of common stairs in plan. The walls are represented by parallel lines scaling 6″ apart, and only the treads of each step are seen. The first is a *box* stair, entirely enclosed by walls. The second and third show two types of *dog-legged*, or *winding* stairs, following the walls on one side and carrying a rail on the open side. The *winders* are triangular in shape, and, on the *line of travel*, that is, the path that a person follows in ascending the stairs, must be the same width as the treads. The last plan is of an *open newel* stair, and illustrates how the short flights end upon platforms, and how the railing forms a *well* in the center. This form of stair takes up considerable space, but its artistic possibilities are limitless; hence it is often employed.

Lay Out. In laying out a staircase, the *rise* must be known. In the "section" upon the Plate, the rise happens to be 8′ 9″, or 105″. Assuming 7″ for the height of the riser, which is the usual height, we find that we must have 15 risers to complete the stair. If the rise had been, let us say, 9′ 6″, we would have had 16 risers each one being 7⅛″ high, and so on. The risers must all be the same height even though they result in a fraction of width. To determine the width of the tread, we know the sum of the riser and the tread must not be more than 17½″, or less than 17″, hence, with our 7″ riser, the tread must be either 10″ or 10½″. Let us accept the former, as by so doing we shall cut down the run. There will be one less tread than there are risers. Working this problem out upon the drawing, lay out the fourteen treads upon the lower floor line, each 10″ wide, and at the last one erect a perpendicular the same length as the rise. Upon this line, starting from the floor, lay off the fifteen 7″ risers. After drawing these in, and completing the string board, lay out the stair well. Make it as small as possible, but still allowing at least 7′ 0″ for head room from the upper face of the step directly under the trimmer.

Usually stairs range in width from 3′ 0″ to 4′ 0″, depending, of course, upon the size of the rooms of the house.

Instructions for Drawing Plate XVI

Margins same as Plate I.

The section and the plans are to be drawn ½″ to the foot, and the detail 2″ to the foot. As mentioned above, the rise of the staircase is 8′ 9″, the treads measure 10″ and the risers 7″. With these dimensions and a good understanding of the text, little difficulty will be experienced in drawing the section. The detail uses the same dimensions for tread and riser, and is self-explanatory. The plans are extremely simple, if the student can imagine himself to be looking straight down upon each tread—a simple application of the principles learned in orthographic projection. Each plan uses treads that scale 10″ wide and 3′ 0″ long.

REFERENCES

Greenberg and Howe—"Architectural Drafting."
Fred T. Hodgson—"Stair Building."

CHAPTER IX

PRELIMINARY PLANNING

With this lesson we begin the actual planning of a house. Heretofore, all chapters have dwelt with various forms of construction. These are certainly essential to the proper planning of a building, as you must know how it is to be constructed or you can not plan it to best advantage.

The Plan of a Building. The plan of a building is a representation of each floor as if the building were cut between this floor and the one above, so as to show all doors, windows, stairs, etc., in their proper relation to each other and to the rooms of the building. It must also show the exact dimension and location of each part. It is evident that it would be impossible for the draftsman to show the plan as it would actually appear if so cut, as each individual stud would appear in section, each window and door frame as if cut in two, and all other parts, as lath, plaster, sheathing, siding, etc. Hence draftsmen have established a conventional method of representing these parts on their plans, which does away with all these details, and still enables the building to be constructed with no trouble on the part of the builder who knows these conventions.

This method applies only to plans—the elevations appearing about as the sides of the completed building will appear.

Conventions. Plate XVII illustrates the usual conventional methods of representation upon plans. These are largely for frame walls 6″ thick. The first elements shown are doors. The outside door is 3′ wide and the inside doors are 2′ 8″. Two methods of drawing the windows are shown—the first when the plans are drawn to the scale of ¼″ to the foot, or larger, and the second when a smaller scale is employed. (Notice that in drawing windows, the wall line is not broken, as is the case when drawing doors.)

A fireplace and common flues are represented as shown. A kitchen sink, laundry tubs, and the conventional wiring symbols complete the plate.

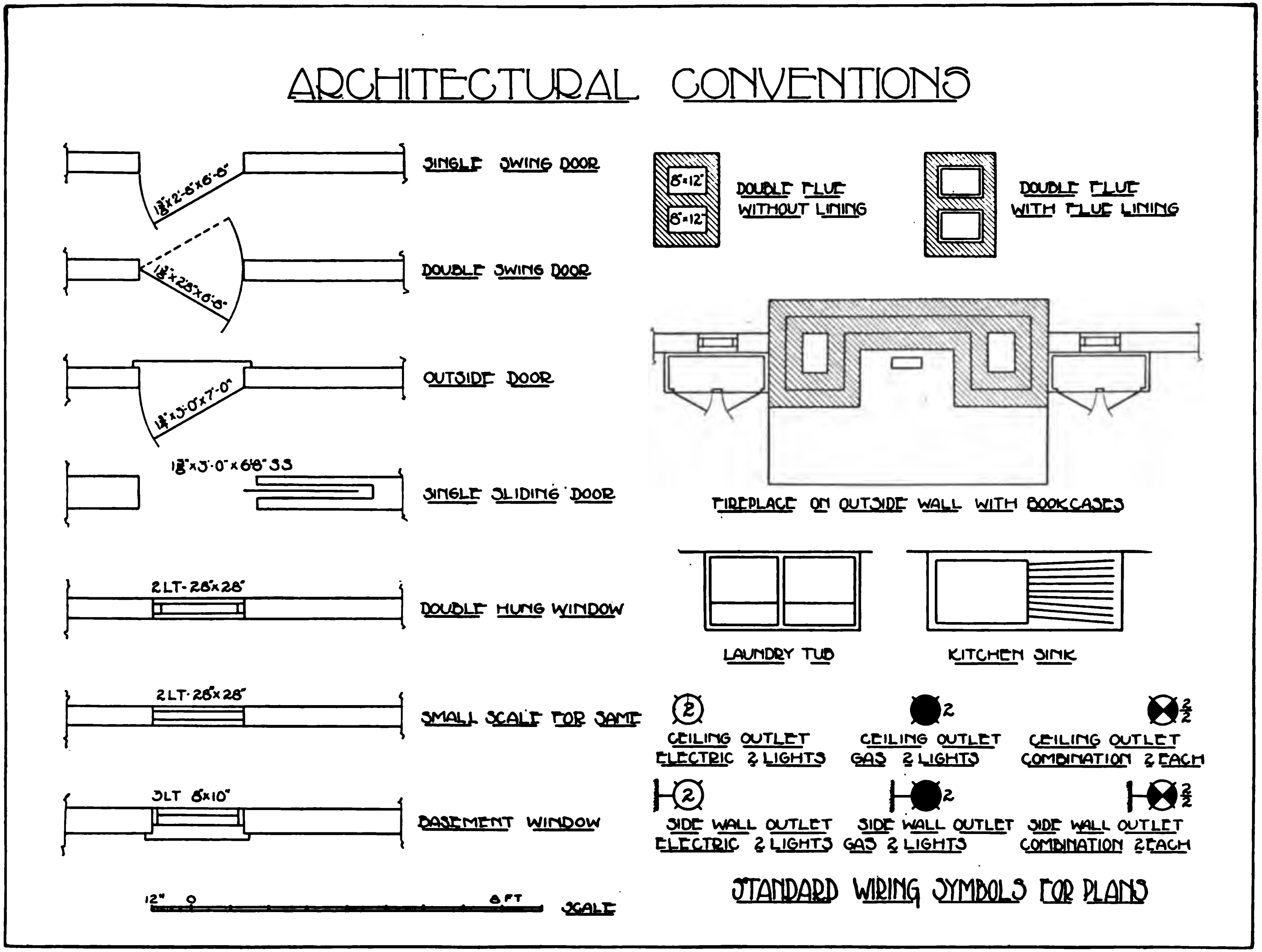
Building Conditions. With these conventions in mind, let us begin our project. It is assumed that we are to plan a two-story frame house not to exceed $3,000 in cost, exclusive of the lot; to contain eight rooms and bath; each bedroom to have a separate closet. The outside finish to be stucco with siding above the first floor, and every detail strictly modern.

The lot is rectangular in shape, 50 feet wide across the front, and 100 feet deep. In front of it stands a park, hence the most desirable porch location will be across the front. As the lot is longer than it is wide, the house can be made rectangular in shape. The soil is firm earth over gravel, which eliminates all foundation difficulties. Sewer, gas, and water pipes pass in front of the lot, which faces the North.

Assuming, let us say, 30 feet by 45 feet as an approximate size for the house—the usual size for frame houses of this class—it would appear as suggested in Figure 30.

Single Line Sketches. The first sketches are single line. The owner of the house we are planning will probably make his ideas known in this manner. He uses single lines to represent the walls, with breaks across them for windows. He does not know the conventions, but he can make his ideas very clear concerning room arrangement and size. Figure 30 illustrates his best effort, and from it we must plan his home.

Conventional Plans. We will begin by tacking a sheet of cross-section paper to the board and placing a sheet of tracing paper upon it, as Plate XVIII illustrates. The little squares of the cross-section paper will serve as a guide for measurement, each square representing a foot. We will draw the


ARCHITECTURAL CONVENTIONS
1 3/8"x2'-8"x6'-8"
SINGLE SWING DOOR
1 3/8"x2'8"x6'-8"
DOUBLE SWING DOOR
1 3/4"x3'-0"x7'-0"
OUTSIDE DOOR
1 3/8"x3'-0"x6'8" S.S.
SINGLE SLIDING DOOR
2LT-28"x28"
DOUBLE HUNG WINDOW
2LT-28"x28"
SMALL SCALE FOR SAME
3LT 8"x10"
BASEMENT WINDOW
12" 0 8FT
SCALE
8"x12"
8"x12"
DOUBLE FLUE WITHOUT LINING
DOUBLE FLUE WITH FLUE LINING
FIREPLACE ON OUTSIDE WALL WITH BOOKCASES
LAUNDRY TUB
KITCHEN SINK
CEILING OUTLET ELECTRIC 2 LIGHTS
CEILING OUTLET GAS 2 LIGHTS
CEILING OUTLET COMBINATION 2 EACH
SIDE WALL OUTLET ELECTRIC 2 LIGHTS
SIDE WALL OUTLET GAS 2 LIGHTS
SIDE WALL OUTLET COMBINATION 2 EACH
STANDARD WIRING SYMBOLS FOR PLANS

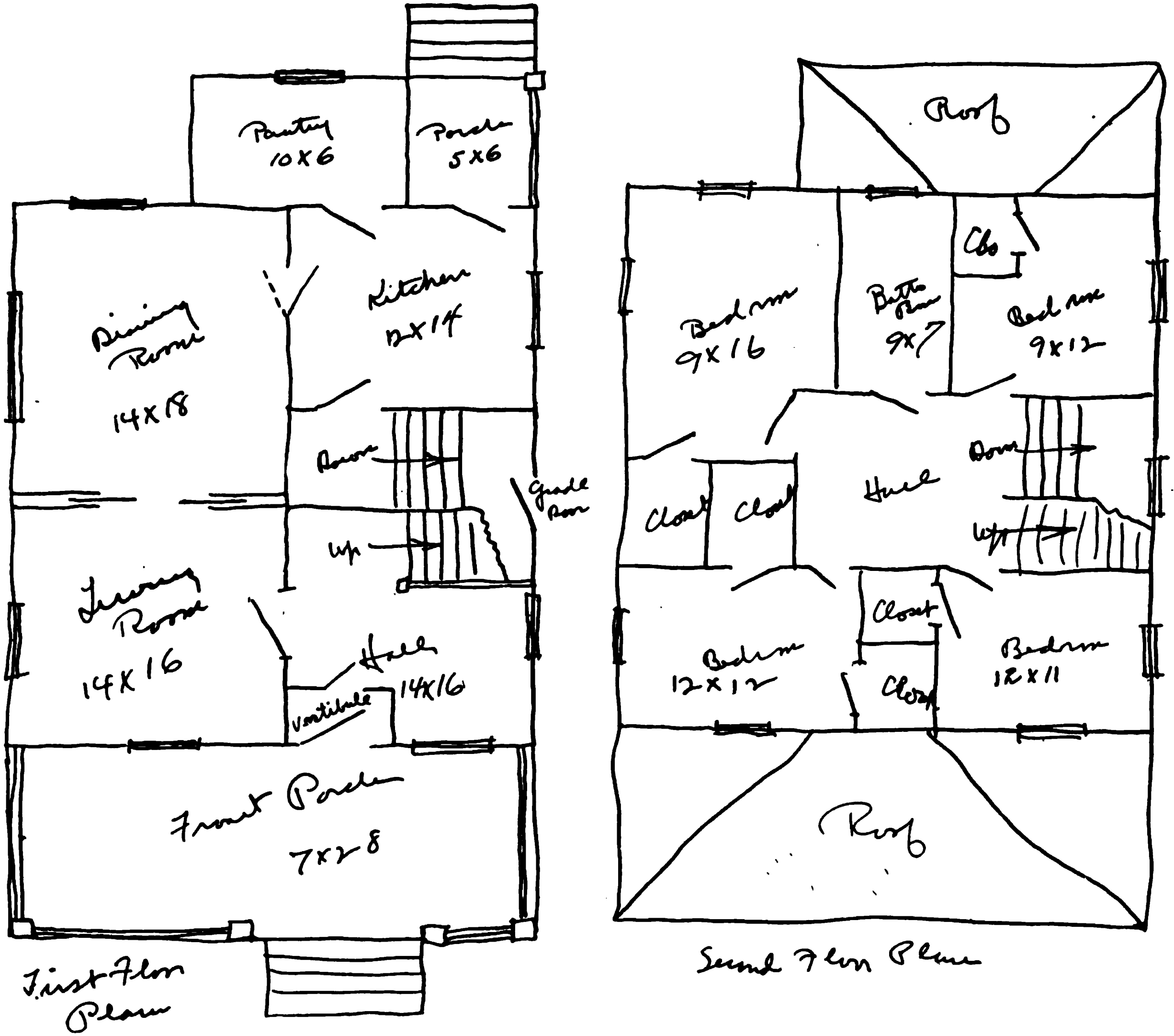

Pantry
10X6
Porch
5X6
Kitchen
12X14
Dining Room
14X18
Down
Grade Door
Up
Living Room
14X16
Hall
14X16
Vestibule
Front Porch
7X28
First Floor Plan
Roof
Clo
Bedroom
9X16
Bath Room
9X7
Bedroom
9X12
Down
Closet
Closet
Hall
Up
Closet
Bedroom
12X12
Closet
Bedroom
12X11
Roof
Second Floor Plan

FIGURE 30.

walls in solid with a rather soft pencil and will not ink them in as the plan may need changing before our client approves it.

First draw the outside walls and then work in the room partitions.

Vestibule. Our client's sketch shows a very important

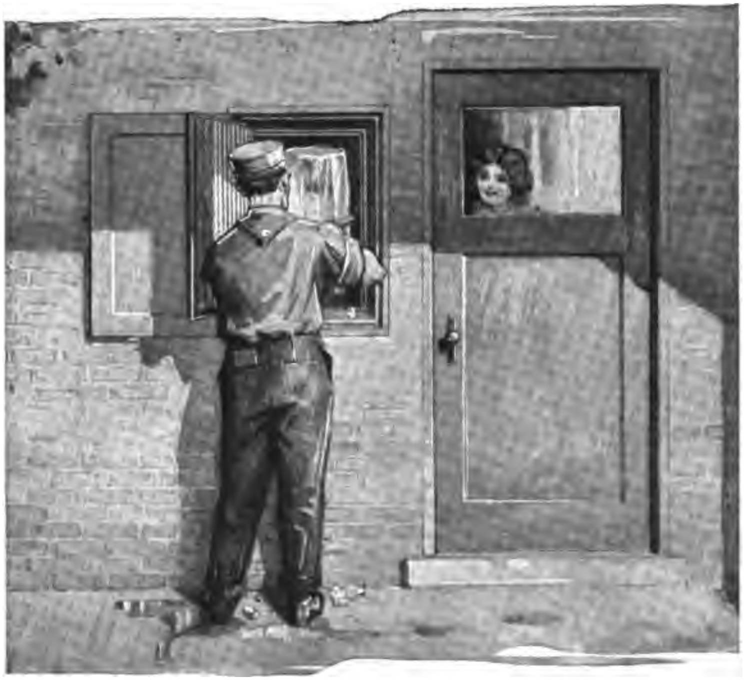


FIGURE 31.

feature—the vestibule that every home should have, providing the appropriation permits. It should contain space for hats, cloaks, rubbers, umbrellas, etc., and should be large enough to permit at least two persons to uncloak at the same time without interfering with each other. It may be built out into the porch; but this plan is not desirable, as it serves to divide the porch in two, and is harder to treat architecturally.

Reception Hall. From the vestibule one enters the reception hall, and a stranger receives his first impression of the interior. Therefore, we must be very careful in planning it so as to be sure that his first impression is a pleasant one.

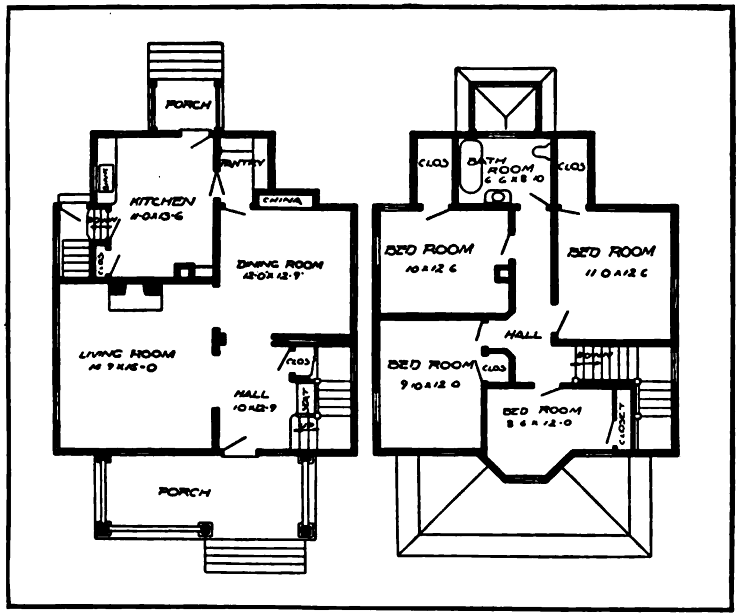


FIGURE 32.

Our client has located the stairs for us—which is the most important feature of the room—at their proper place. But he has neglected to provide passage through to the kitchen, which is very necessary, if mud is to be kept out of the other rooms. Therefore, we will cut off the large cellar opening that he has planned on, and convert it into a passage, placing a door from it into both dining room and kitchen.

Living Room. As the living room and reception hall are both so closely related, we will connect them with a collonade, thereby throwing them into one room. If he had desired it, we would have placed a fireplace on the wall directly opposite this opening, but in this particular case, where all luxuries must

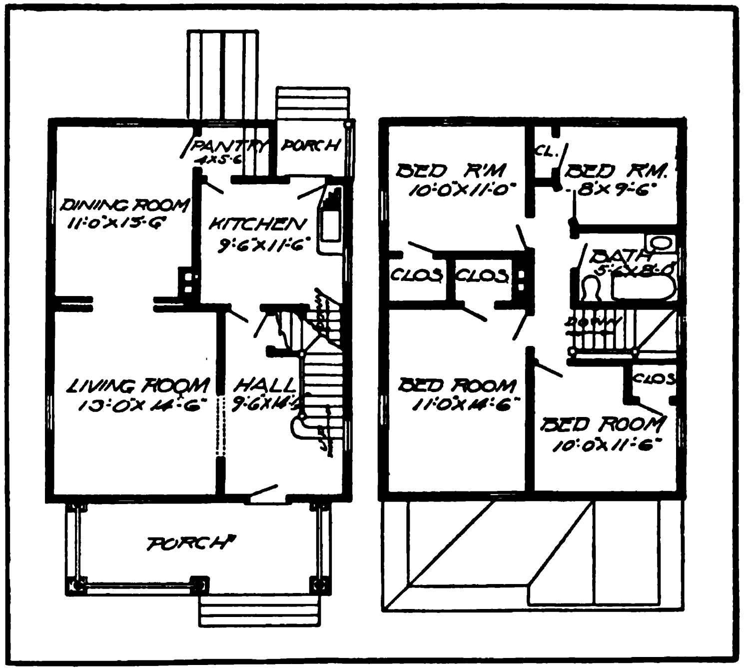


FIGURE 33.

be barred to still keep within the appropriation and not slight anything more necessary, it must be omitted.

Dining Room. Double doors will connect the living room and dining room, thereby shutting them off from each other, if desired. This latter room should be made one of the most cheerful, having direct morning sunlight entering into it, if possible. In our case it will, as we have East and South exposure, since our building faces the North.

Kitchen and Pantry. Direct communication from the dining room into the kitchen is not desirable, as odors of cooking and a clear view into the kitchen are most unpleasant, especially when having visitors. Hence we will adopt a pantry having swinging doors into both kitchen and dining

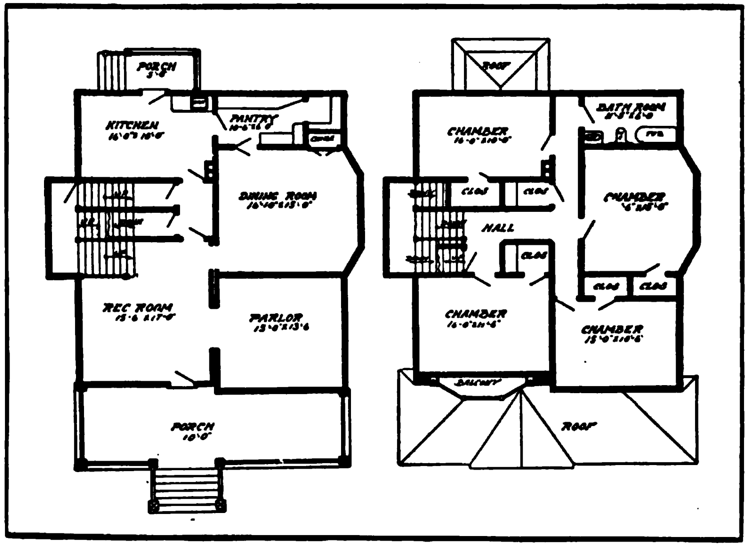


FIGURE 34.

room, which will afford a passage between same. In one end of the pantry we will plan the refrigerator, having an outside icing door, thus eliminating all mud and muss that would be tracked through the kitchen by the ice man. Figure 31 illustrates this convenience. We will also provide plenty of shelving in the pantry, which is very necessary. The kitchen need not be large, as it will contain only a sink, stove, and table, and the distance between them must not be great.

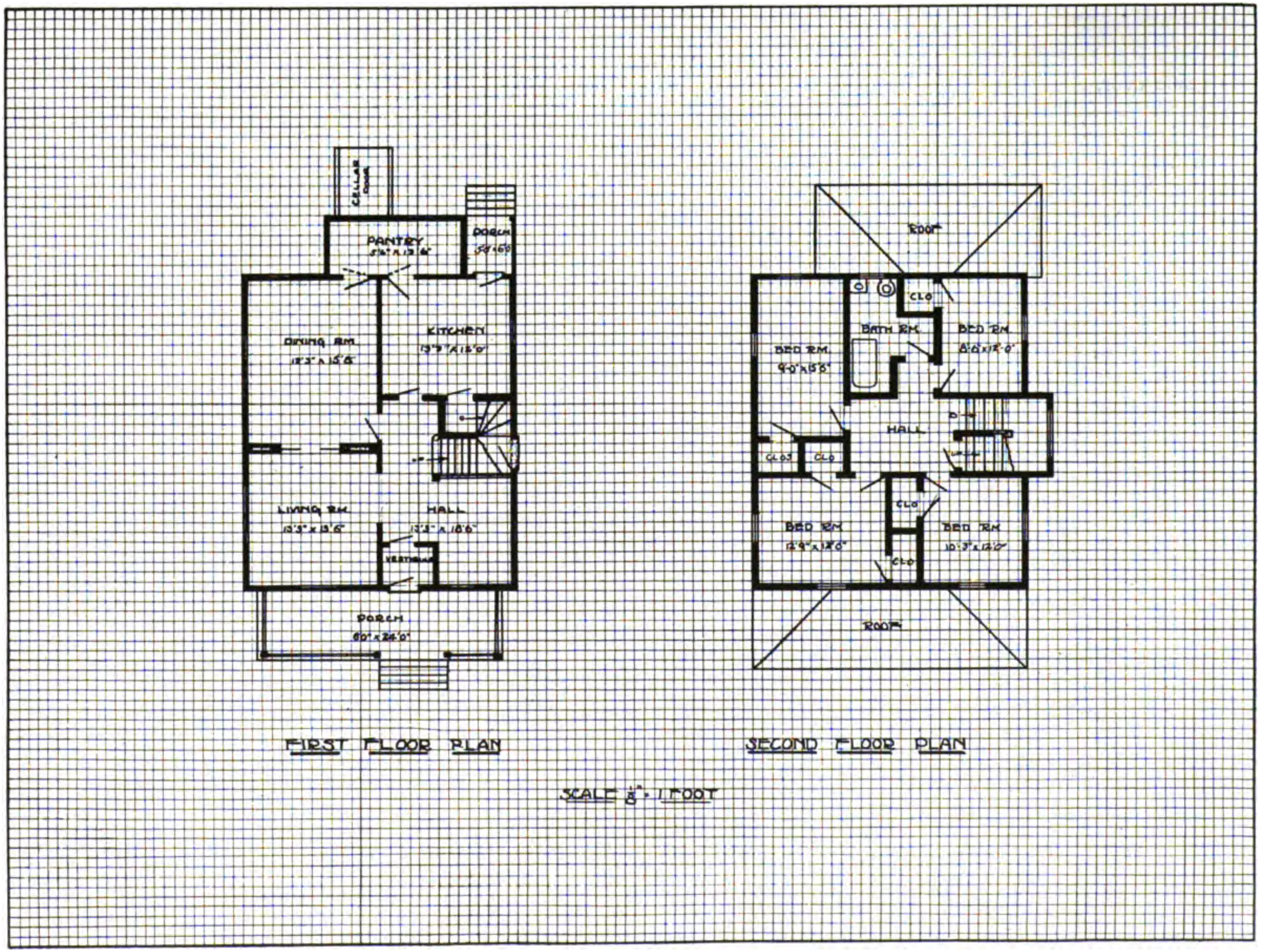

CELLAR DOOR
PANTRY
PORCH
DINING RM.
KITCHEN
LIVING RM.
HALL
PORCH
ROOF
BED RM.
BATH RM.
BED RM.
CLO
HALL
CLO
BED RM.
BED RM.
ROOF
FIRST FLOOR PLAN
SECOND FLOOR PLAN
SCALE 1/8" = 1 FOOT

PLATE XVIII.

The cellar can be entered through the kitchen and an outside grade door, both of which will be shown on this plan.

Bedrooms. Ascending the stairs, a hall should be provided whereby entrance can be made into any of the rooms or the bath, without passing through another room. Each bedroom should be planned with a separate closet, and all closets should be on inside walls. If possible, each bedroom should have two windows opening into it, and space should be provided for the head of the bed against an inside wall.

Bathroom. The bathroom is usually a small room, but it should contain at least one window and space for a tub, basin, and seat. If closet space can be provided, it is most desirable for the storage of linens, etc. It should always be located over the kitchen, so that the service pipes may be kept in one part of the building.

This completes our conventional drawings according to the owner's ideas. In Figures 32, 33 and 34, we have worked up other suggestions for room arrangement that we will submit to him, but they are not as ideal as the ones in Plate XVIII.

Instructions for Drawing Plates XVII and XVIII

Margins same as Plate I.

Plate XVII is drawn to the scale of ½" to the foot, with the exception of the wiring symbols, which are enlarged and drawn to no scale. Dimensions omitted in the drawing can be scaled, as in the other Plates of the course.

Before making conventional drawings, the student should work up a number of free-hand sketches of some house of his own design—the conditions of its building being dictated by the teacher.

The best of these sketches should then be worked up on tracing paper, as in Plate XVIII. They need only be penciled, but accurate scaling should be observed.

REFERENCES

E. J. Lake—"Suggestions for Architectural Drawing for High Schools." Industrial Arts Magazine, February, March, April, 1914.

Radford Architectural Co.—"Architectural Drawing."

CHAPTER X

WORKING DRAWINGS

When the preliminary plans have been approved, the draftsman is instructed to get out a set of working drawings from them.

Working Drawings. In architecture, working drawings are *all* plans, elevations, and details needed by the builder—supplemented by the specifications—on which to estimate and by which to construct the building. They must show *all* dimensions, etc., properly scaled; any peculiarities of construction must be made clear on them; and they must be so complete that no "extras" can be charged up against the owner by the contractor who bid upon the job as it stands in the working drawings and specifications.

First Floor Plan. The plan of the first floor is usually the first to be drawn. With the conventional drawings to follow, it is a rather simple matter to draw any plan. Practically all residence drawings are made to the scale of ¼″ to the foot. Work the outside walls in first, scaling 6″ for frame buildings, and then the partitions and details. Completely dimension it. Even though it scales exactly, the dimensions are of greater importance.

Second Floor Plan. The outside walls of this plan, and the main partitions, are taken from the first floor plan. If possible, run the second floor partitions over the first, or as near them as practical.

Basement Plan. The plan of the basement is worked up from the first floor plan, also. Its outside dimensions are the same. The main wall of concrete 12″ thick, rests upon an 18″ footing, and runs up to the grade line. There it is topped with three layers of cement blocks; hence the wall will scale 8″ on the drawing. Through the center, to support the long span of the joists, a girder is run. This, in turn, is upheld by posts resting on a concrete footing. Care must be taken to dimension the basement plan exactly, as it is the foundation, and the first part of the building that is to be constructed. Some draftsmen will locate the heater, soil pipe, and sewer outlet on this plan, although, on a small job such as this, the plumbing and heating contractor would rather do it.

Elevations. The elevations come next. The floor plan is placed above the elevation that is being drawn, and the points projected to it. When one elevation is finished, its heights can be projected to the next in the same manner. A study of the Plates will make all representations clear.

Section. A scaled section clears up a great deal of confused detail. Plate XXVI is a vertical section of the house, and illustrates all trim, stairs, and constructive details, in such manner that there is left little room for confusion. This section is one of the most important parts, and it should not be neglected in any way.

Details. Plate XXVII gives the wall sections, making their construction very clear, and Plate XXVIII full size details of a few of the most important parts. In actual practice, these full size details are usually penciled by the architect and handed to the contractor as the work progresses. This Plate also shows a stair detail to a smaller scale. As many of these details may be drawn as desired.

Instructions for Drawing Plates XIX, XX, XXI, XXII, XXIII, XXIV, XXV, XXVI, XXVII, XXVIII

A larger sheet of paper than the usual size may be used, if desired. Borders 16″ x 24″ are suggested, as two plans or elevations can then be drawn on one sheet, which will permit a greater amount of projecting. The first and second

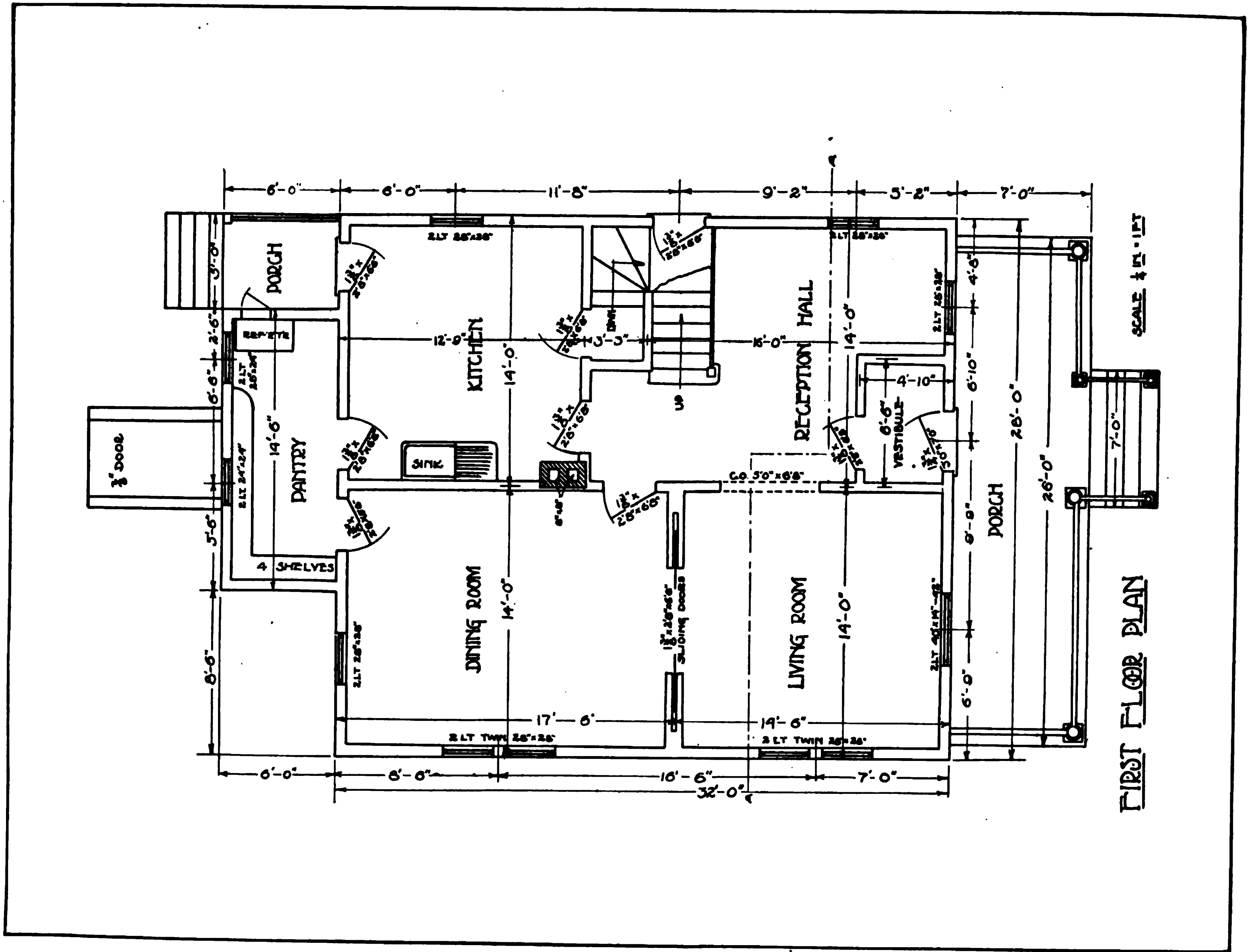

FIRST FLOOR PLAN
SCALE 1/8 IN = 1 FT
PORCH
PANTRY
KITCHEN
SINK
4 SHELVES
DINING ROOM
RECEPTION HALL
VESTIBULE
LIVING ROOM
SLIDING DOORS
UP
3/4" DOOR
32'-0"
28'-0"
26'-0"

PLATE XIX.

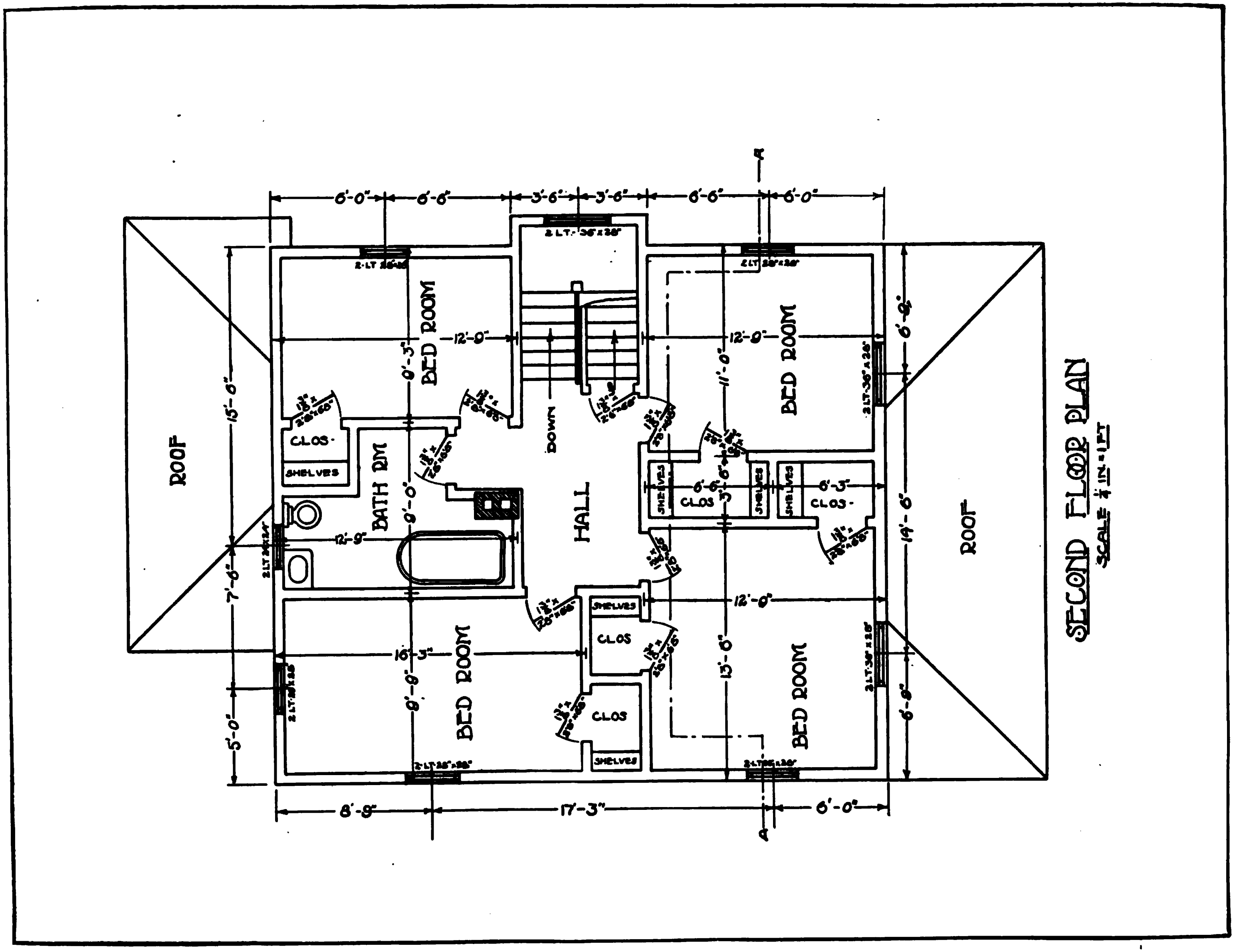

SECOND FLOOR PLAN
SCALE ¼ IN = 1 FT
ROOF
BED ROOM
BATH RM
HALL
DOWN
CLOS
SHELVES
ROOF

PLATE XX.

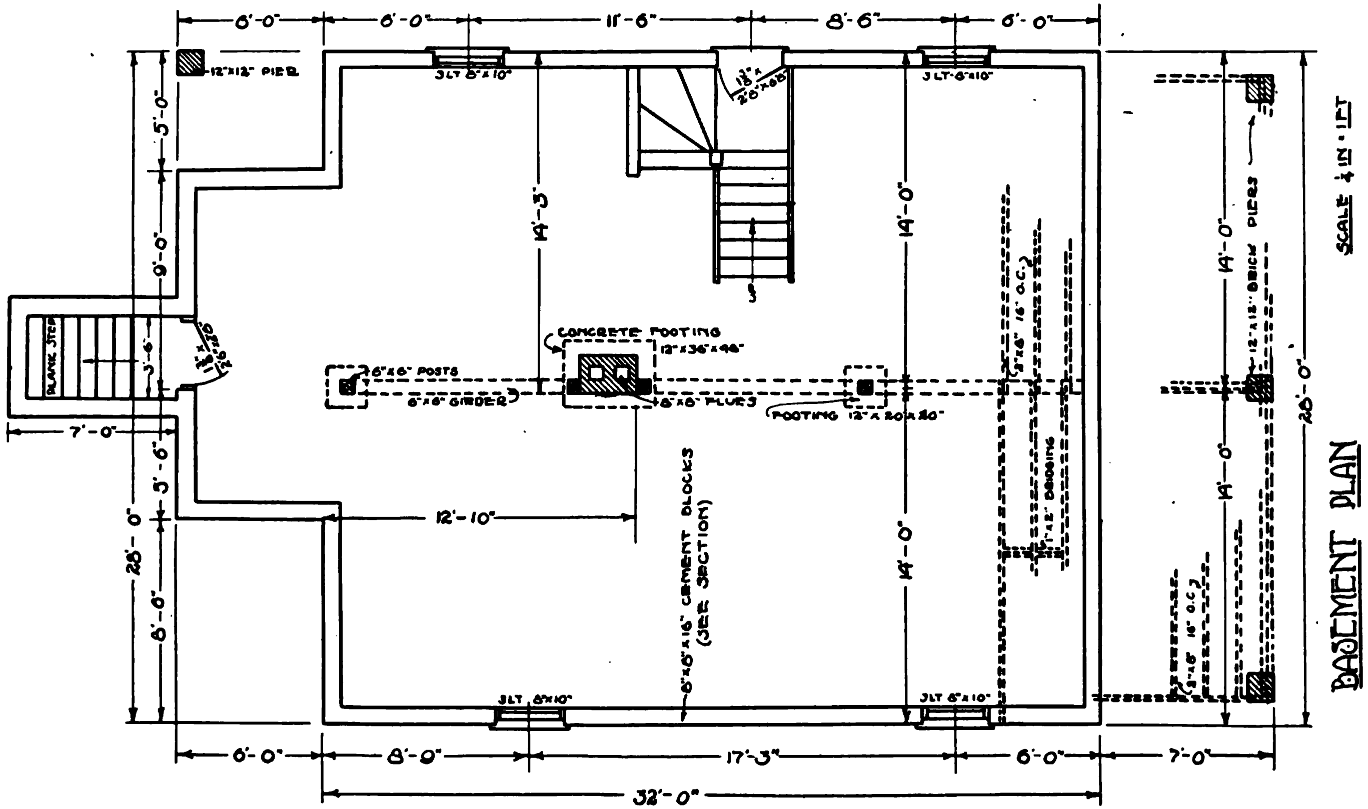

BASEMENT PLAN
SCALE ¼ IN = 1 FT
12"x12" PIER
3 LT 8"x10"
6"x6" POSTS
6"x6" GIRDER
CONCRETE FOOTING
12"x36"x48"
8"x8" FLUES
FOOTING 12"x20"x20"
8"x8"x16" CEMENT BLOCKS
(SEE SECTION)
PLANK STEP
2"x8" 16" O.C.
1"x2" BRIDGING
12"x12" BRICK PIERS
6'-0"
11'-6"
8'-6"
14'-3"
14'-0"
5'-0"
9'-0"
3'-6"
7'-0"
28'-0"
8'-6"
12'-10"
8'-0"
17'-3"
32'-0"

PLATE XXI.

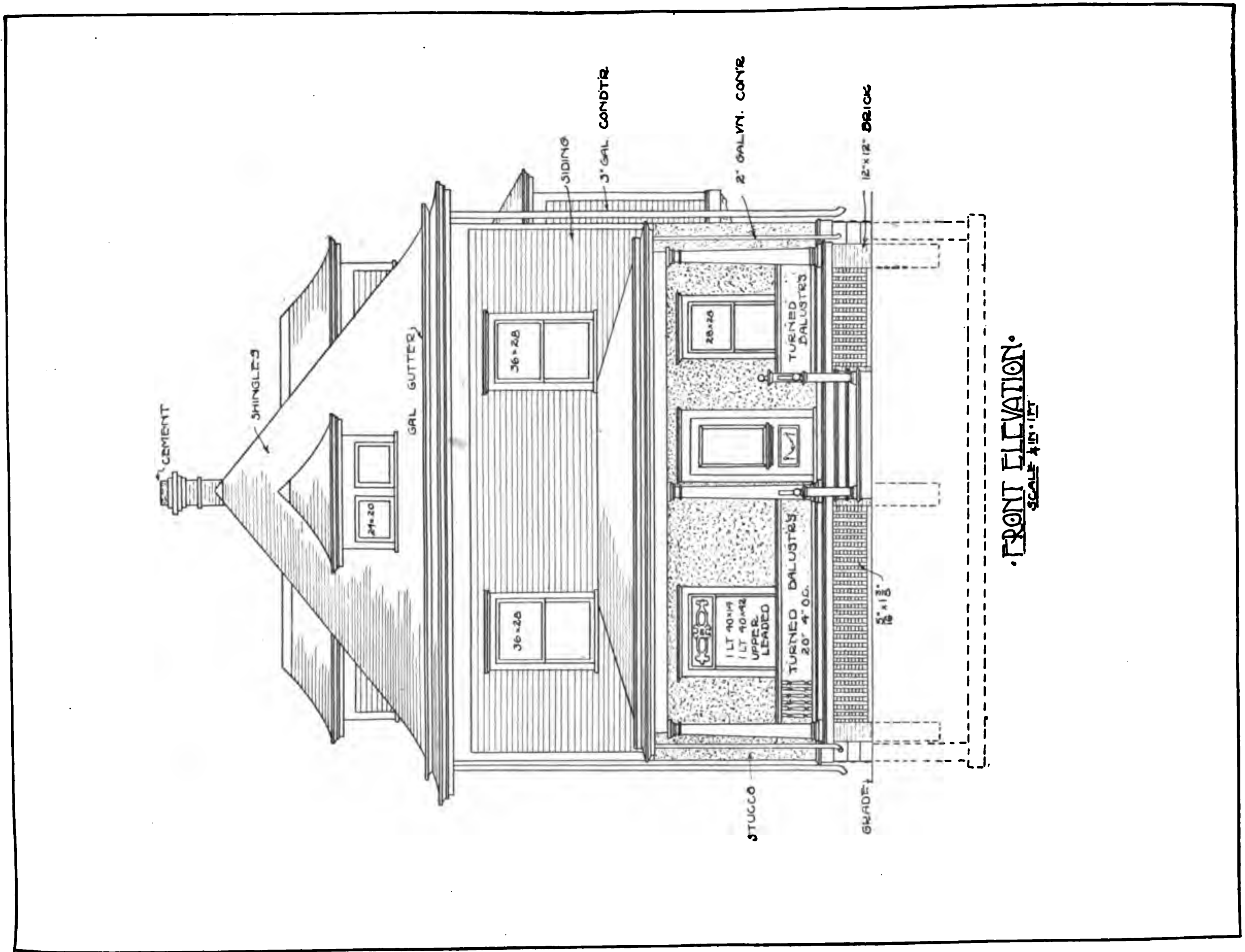

FRONT ELEVATION.
CEMENT
SHINGLES
GAL GUTTER
SIDING
3" GAL CONDTR
2" GALVN. CONDR
12"x12" BRICK
24x20
36x28
36x28
28x28
TURNED BALUSTRS
1 LT 40x14
1 LT 40x42
UPPER LEADED
TURNED BALUSTRS
20" 4" O.C.
STUCCO
GRADE

PLATE XXII.


SHINGLES
GAL IRON
24x28
28x28
28x28
SIDING
36x28
28x28
WOOD BRACKET
STUCCO
28x28
OUTSIDE ICING DOOR
TURNED COLUMN
TURN'D BALUST'RS
BALUSTERS
BALUSTERS
8x10
CEMENT BLOCKS
BRICK
·RIGHT SIDE ELEVATION·
SCALE ¼ IN = 1 FT

PLATE XXIII.

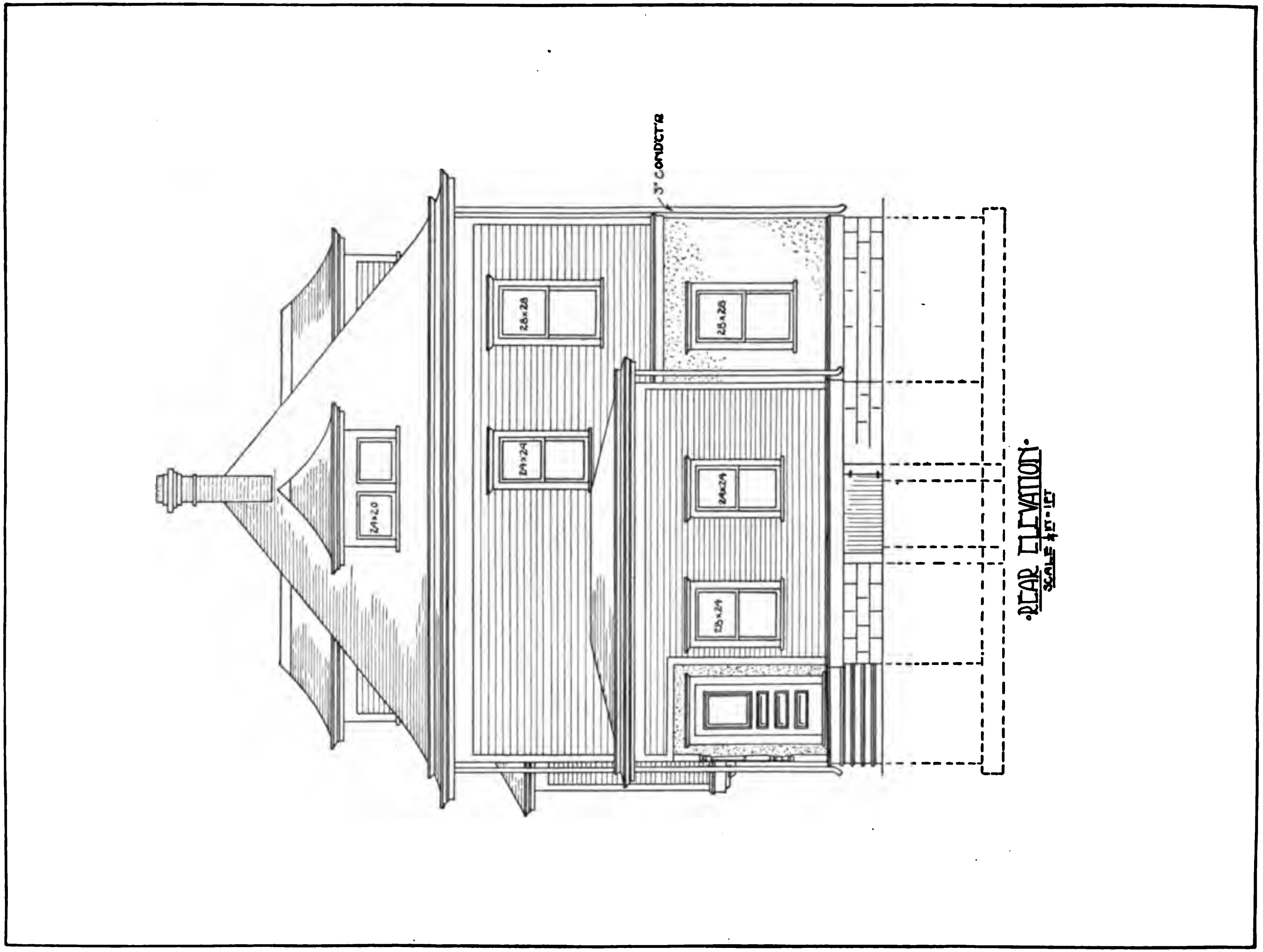
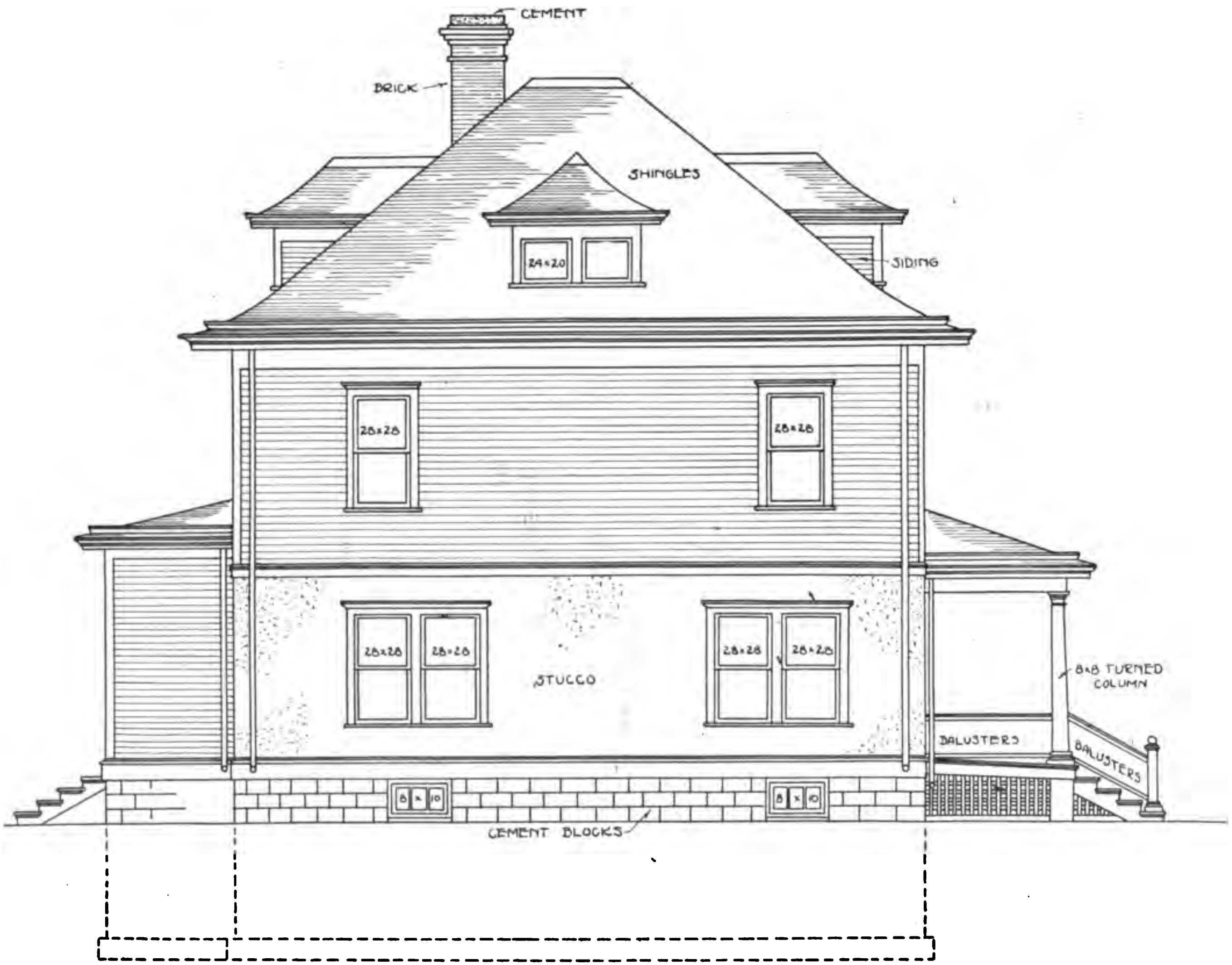


PLATE XXIV.



·LEFT SIDE ELEVATION·
SCALE ¼ IN = 1 FT

PLATE XXV.

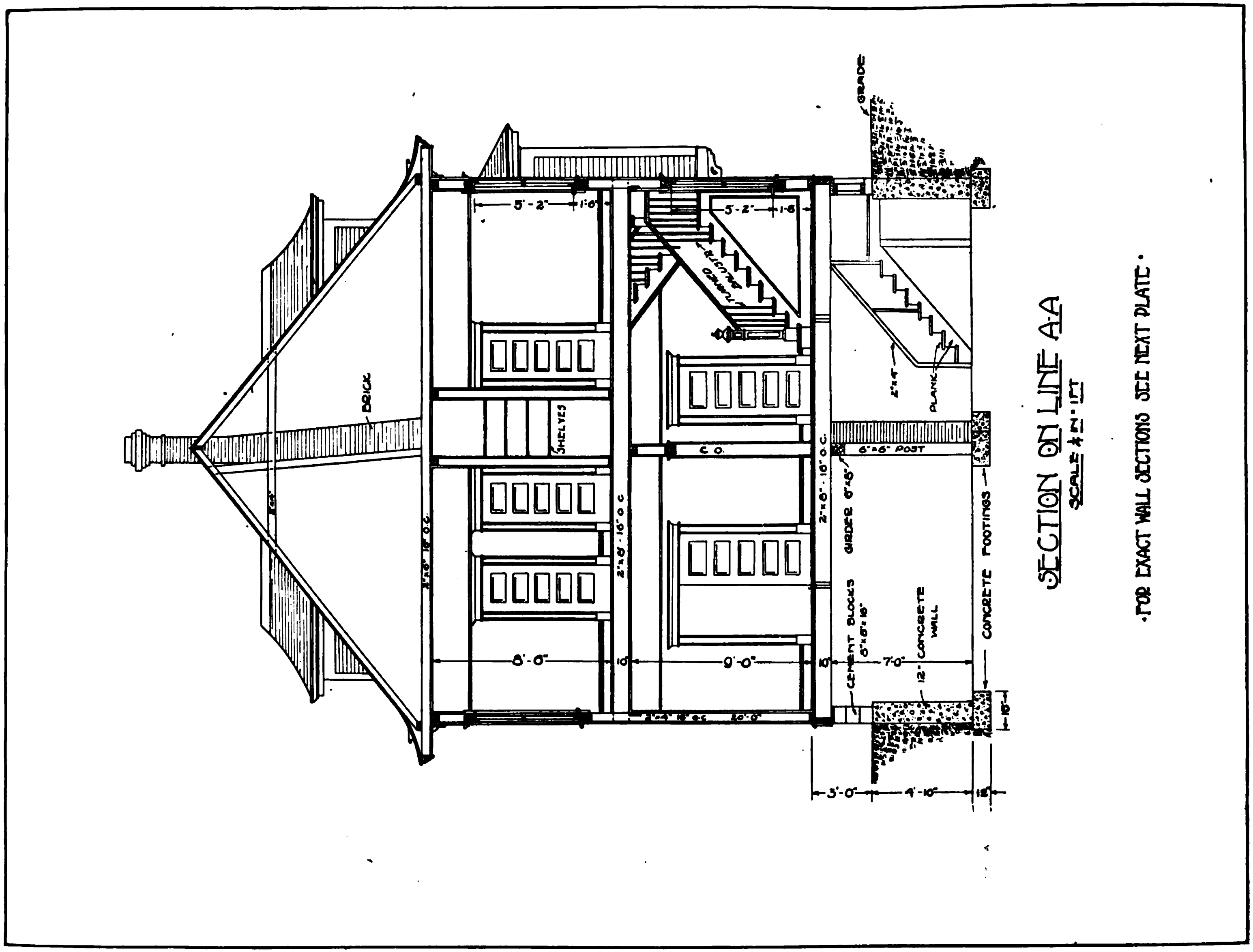
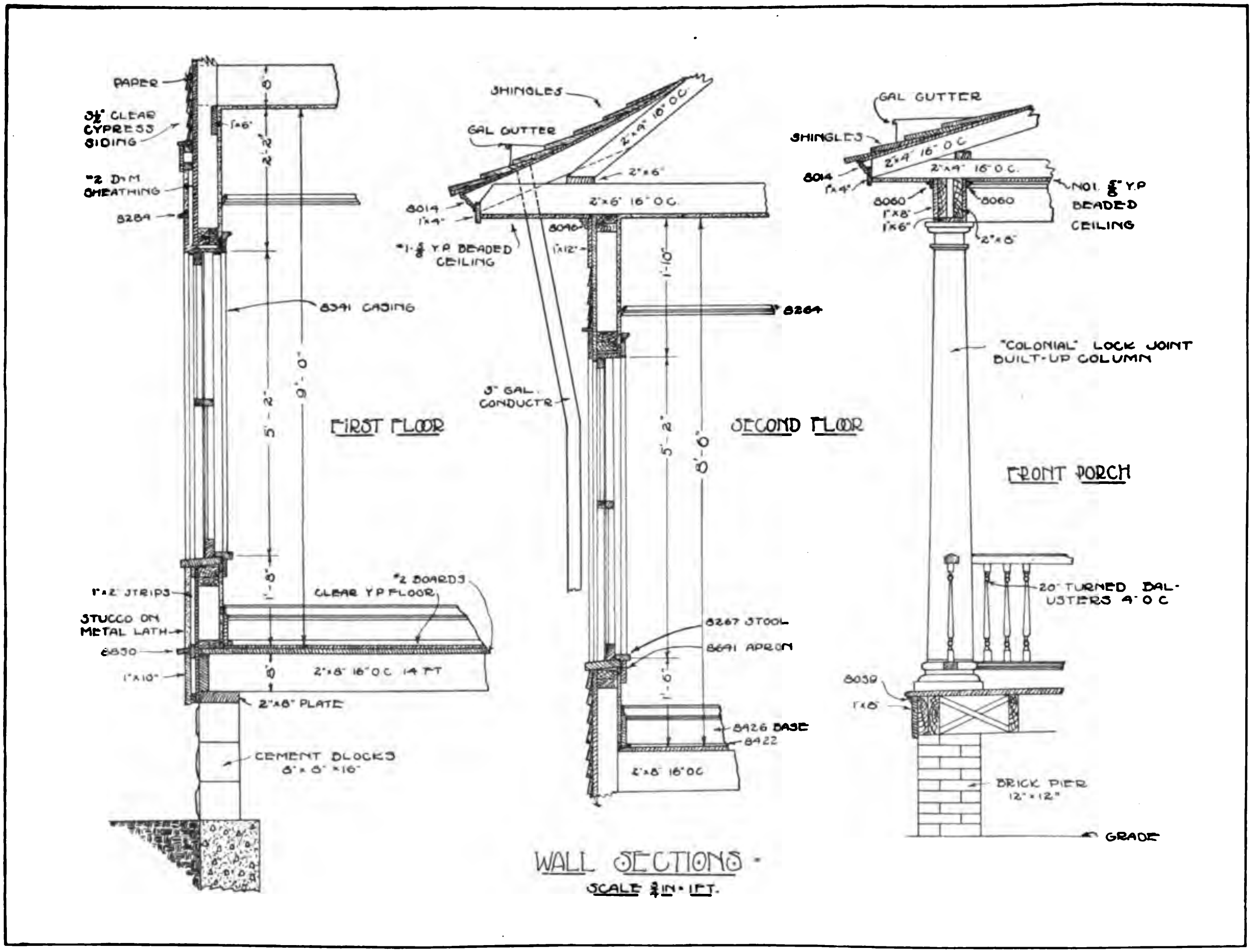
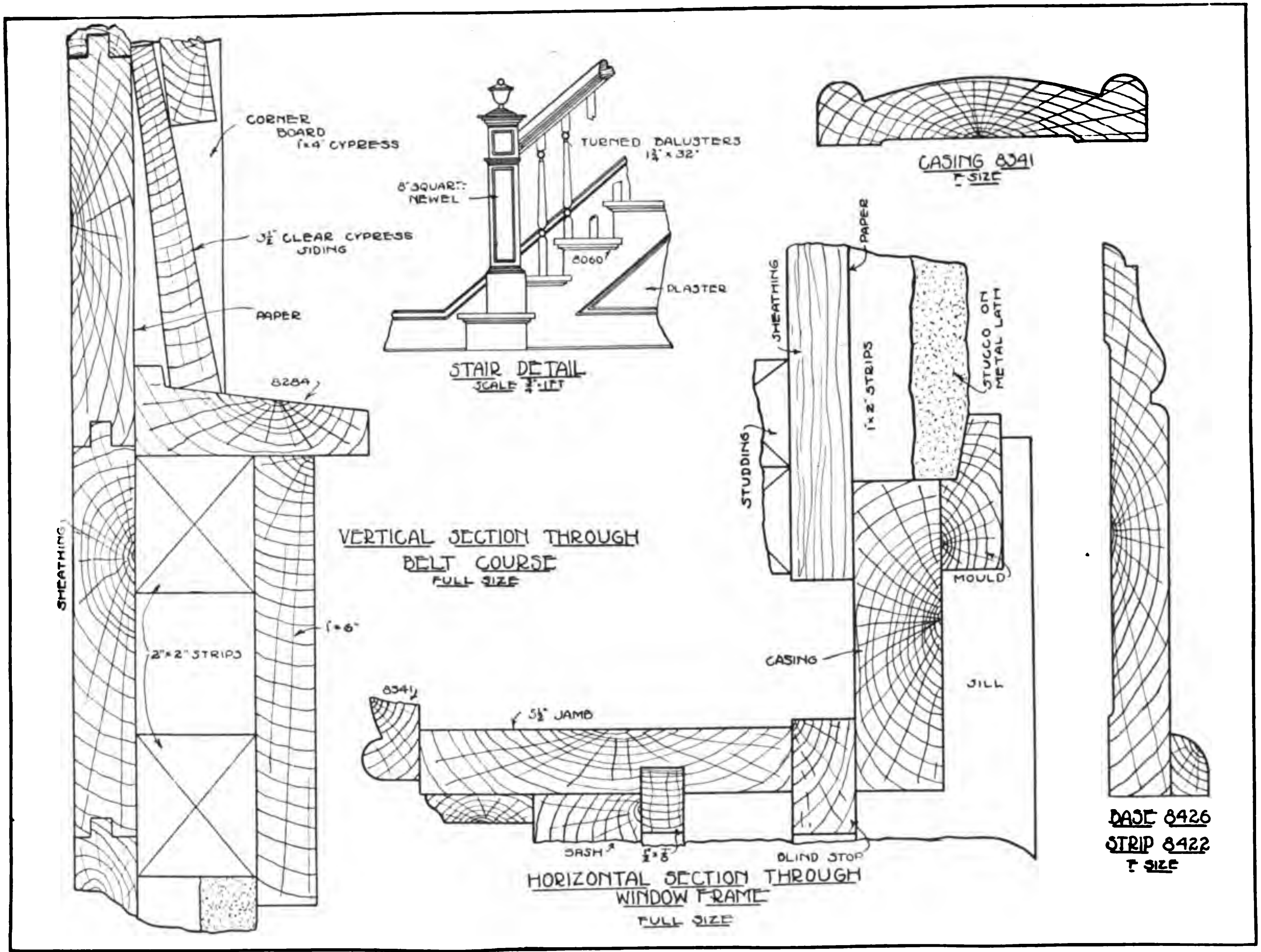

SECTION ON LINE A-A
SCALE 1/4 IN = 1 FT
FOR EXACT WALL SECTIONS SEE NEXT PLATE
GRADE
BRICK
SHELVES
C.O.
6"x6" POST
GIRDER 6"x8"
CEMENT BLOCKS 8"x8"x16"
12" CONCRETE WALL
CONCRETE FOOTINGS
PLANK
2"x4"
5'-2"
1'-6"
8'-0"
9'-0"
7'-0"
3'-0"
4'-10"

PLATE XXVI.



PAPER
3½" CLEAR CYPRESS SIDING
1"x6"
"2 D&M SHEATHING
8289
8391 CASING
9'-0"
5'-2"
2'-2"
1'-8"
FIRST FLOOR
1"x2" STRIPS
STUCCO ON METAL LATH
8830
1"x10"
"2 BOARDS
CLEAR Y.P FLOOR
2"x8" 16" O.C. 14 FT
2"x8" PLATE
CEMENT BLOCKS 8"x8"x16"
SHINGLES
GAL GUTTER
2"x4" 16" O.C.
2"x6"
2"x6" 16" O.C.
8014
1"x4"
8090
1"x12"
"1-⅝ Y.P BEADED CEILING
8264
3" GAL. CONDUCTR
SECOND FLOOR
1'-10"
5'-2"
8'-6"
1'-6"
8267 STOOL
8691 APRON
8426 BASE
8422
2"x8" 16" OC
GAL GUTTER
SHINGLES
2"x4" 16" O C
2"x4" 16" O.C.
8014
1"x4"
8060
1"x8"
1"x6"
8060
2"x8"
NO1 ⅝" Y.P BEADED CEILING
"COLONIAL" LOCK JOINT BUILT-UP COLUMN
FRONT PORCH
20" TURNED BAL-USTERS 4'-0 C
8039
1"x8"
BRICK PIER 12"x12"
GRADE
WALL SECTIONS -
SCALE ⅜ IN = 1 FT.

PLATE XXVII.


CORNER BOARD 1"x4" CYPRESS
3½" CLEAR CYPRESS SIDING
PAPER
8284
SHEATHING
2"x2" STRIPS
1"x6"
VERTICAL SECTION THROUGH BELT COURSE
FULL SIZE
TURNED BALUSTERS 1¾" x 32"
8" SQUARE NEWEL
8060
PLASTER
STAIR DETAIL
SCALE ¾"=1FT
CASING 8341
F SIZE
PAPER
SHEATHING
1"x2" STRIPS
STUCCO ON METAL LATH
STUDDING
MOULD
CASING
SILL
8341
5½" JAMB
SASH
⅞"x⅞"
BLIND STOP
HORIZONTAL SECTION THROUGH WINDOW FRAME
FULL SIZE
BASE 8426
STRIP 8422
F SIZE

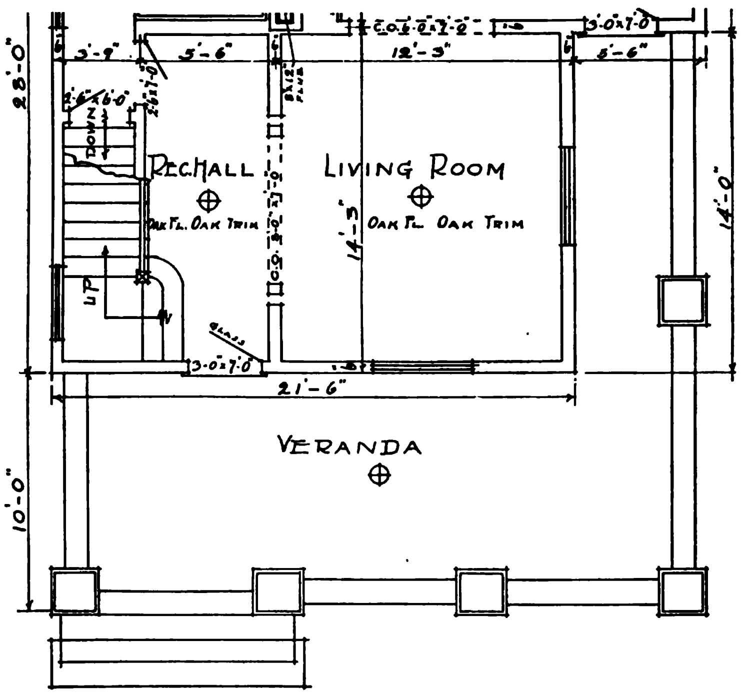


FIGURE 35.

floor plans should comprise the first sheet; the basement plan and the section, the second; the front and right side elevations, the third; the rear and left side elevations, the fourth; and the details, the fifth.

No drawing should be inked or traced until the entire set has been completed in pencil. Then a tracing of each and a set of blue prints is to be desired.

Any details of drawing, such as the laying out of the stairs, can be recalled by referring back to the proper section in the first part of the book.

The rendering of lines upon the Plates is strictly mechanical. In Figure 35 we have illustrated a part of a plan showing the average architect's free and easy rendering. The lines run past the corners, giving the drawing freedom of expression—"snap"—and encouraging carelessness. Under no circumstances should the beginning student adopt it. It permits great speed in penciling and inking—which fact tends to make the draftsman careless. If the student is slow and careful at the start, this speed and "snappy" line will come later without any fear.

REFERENCES

C. F. Edminster—"Architectural Drawing."
Radford Architectural Co.—"Architectural Drawing."
Percy H. Sloan—"Architectural Drawing."

CHAPTER XI

PERSPECTIVE

The phenomenon of perspective is so familiar that it needs little explanation here. Nature furnishes countless examples. The farther away a body is, the smaller it becomes in our vision.

Kinds of Perspective. There are two kinds of perspective —angular and parallel. If we look at an object and imagine there is a vertical plane of glass between that object and our eye, the intersection of the visual rays from points of the object to our eye, with the glass plane, will locate points in the perspective of the object. If these points on the glass are connected, we have a *perspective view* of the object.

Angular Perspective. If the glass plane—which we will call the *picture plane*—makes an angle with the object, as it would when viewing a building toward its diagonal, the resultant perspective is *angular*. The observer's eye is the *station point*, and an imaginary line from his eye at right angles to the picture plane and continuing to the object, is the *line of direction*. Where it intersects the object, the point is known as the *center of vision*. A horizontal plane passing through the observer's eye and at right angles to the picture plane, gives us, at the intersection of these two planes—the *horizon*. All horizontal lines of the object, if continued, run toward this horizontal line, where they vanish. They vanish on the left at the *vanishing point left*, and on the right, at the *vanishing point right*. All vertical lines of the object remain vertical in the perspective. Figure 36 clearly illustrates these points.

How to Draw a Perspective. Figure 37 is a rough diagram of the perspective layout of the house presented in the working drawings. It is in what is known as 45 degree perspective, and is drawn as follows:

Near the upper edge of the board, the first floor plan is tacked so that its front and right walls make angles of 45 degrees with the horizontal. The front and left could be used as well, if it is the left side that the draftsman wishes to show. At its lowest corner, a horizontal line is drawn—the *trace of the vertical picture plane*. This line represents the revolved plane mentioned above. It is necessary to revolve it to bring it into the plane of the paper.

At the fore corner of the house, draw the line of direction, *CV-SP*, locating the station point. This should be about three times the height of the house. From *SP* draw lines at 45 degrees until they intersect the trace of the vertical plane at *A* and *B*. Tack the front elevation on the left or right of the plan, and a little below it.

Next locate the horizon line at the height from which it is desired the house is to be observed, and drop verticals from *A* and *B* to intersect this line. The vanishing points on the left and right are thus located. You are now ready to draw your perspective.

All points on the plan that are desired in the perspective are projected toward *SP*. Where they intersect *AB* they are dropped as verticals. All points on the elevation are projected horizontally to *CV-SP*, and then to the vanishing points. The intersection of the two projections of the same point, will give you that point in the perspective. The front corner of the house from the roof to the grade line is on the line of direction; hence it will be the only line in the perspective that is drawn in the size of the elevation. All lines running from the left of this corner will converge at *VPL* and all lines on the right at *VPR*.

To find the perspective of the ridge, first project its height from the elevation to *VPL*, and where it intersects the down

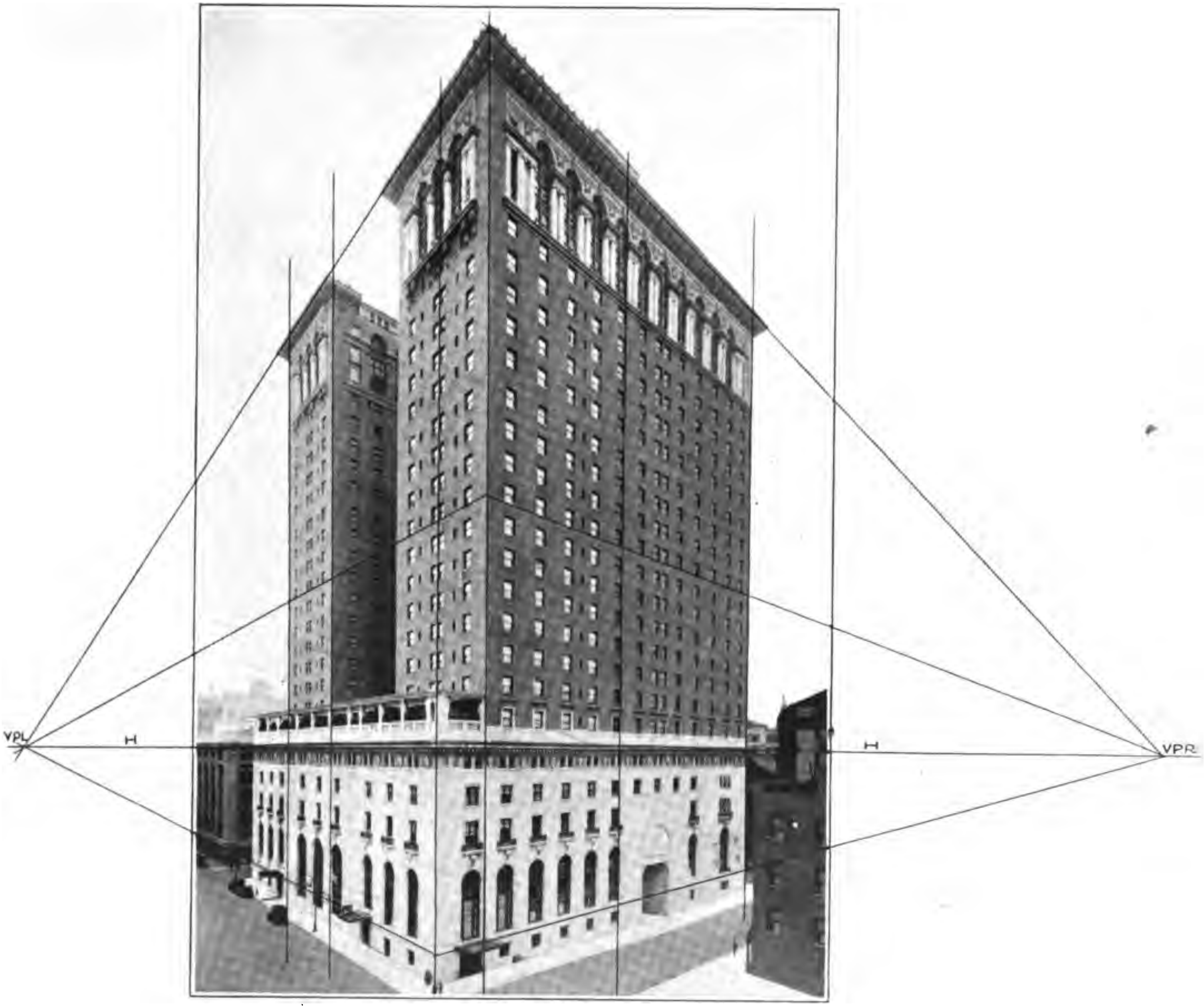


FIGURE 36.

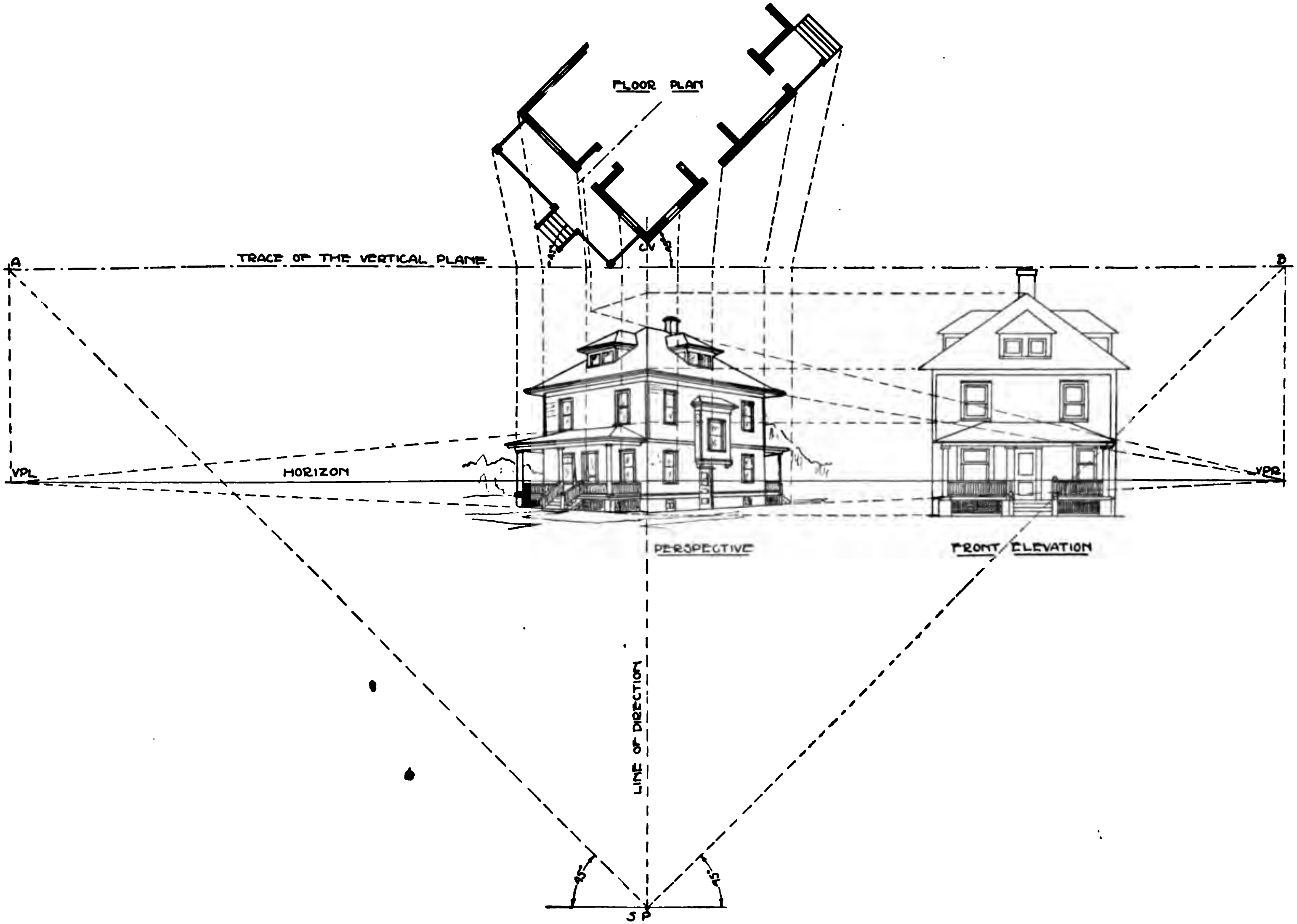

FLOOR PLAN
TRACE OF THE VERTICAL PLANE
A
B
CV
VPL
HORIZON
VPR
PERSPECTIVE
FRONT ELEVATION
LINE OF DIRECTION
45°
45°
SP

FIGURE 37.

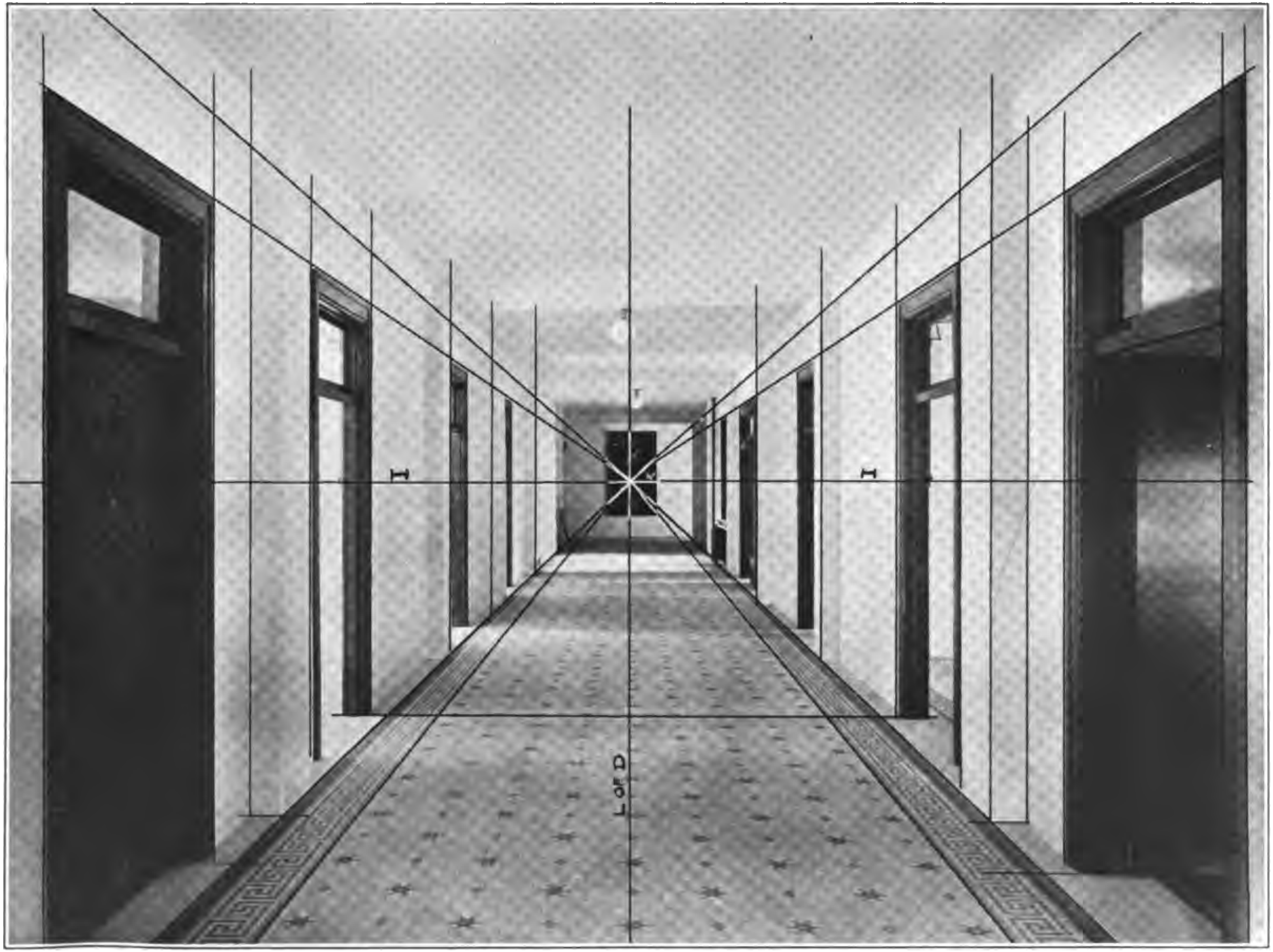


FIGURE 38.

line from the center of the plan, project it back to *VPR*. This will give the perspective of the ridge from the line of direction to the right.

If more of the side is desired in the perspective, make its angle in the plan 30 degrees and the front 60 degrees. Then draw the lines from the station point parallel to these sides, and proceed in the same manner.

Parallel Perspective. If the picture plane is parallel to one side of the object, one vanishing point is the result. Figure 38 illustrates this condition. All verticals remain vertical, and all horizontals that are parallel to the picture plane, horizontal. This is known as parallel perspective, and is used for interiors and street studies where the width of the picture is not great. In our work it has so little practical application that we will not take it up in detail.

REFERENCES

F. F. Frederick—"Simplified Mechanical Perspective."
B. J. Lubschez—"Perspective."
American School of Correspondence—"Perspective Drawing."

To the Teacher: Although it is not necessary to the perspective drawing of a building—since the data given in this Chapter has proven sufficient in every case—it may be of interest to give the student a few elementary problems such as those suggested in "Simplified Mechanical Perspective," Frederick.

CHAPTER XII

SHADES AND SHADOWS

In order to clearly define on paper the appearance that a building or other object would present in reality, a knowledge of shades and shadows is necessary. Any object in the light will cast a shadow, and any side of an object from which the light is cut off will be in shade—more or less according to the amount of reflected light it may receive.

Conventionally, it is assumed that the source of light—

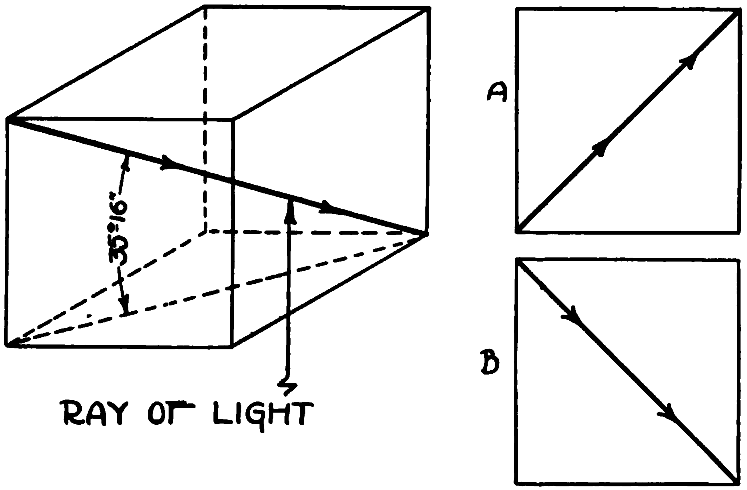


FIGURE 39.

the sun—is in a position over the left shoulder of the observer, and that all rays from the sun are parallel. In interiors, the rays are sometimes regarded as coming from artificial light, and hence are conical.

In Figure 39, we conceive a ray of light as being the diagonal of a cube, falling from the upper left-hand corner to the lower right-hand. In plan it appears as at A, and in elevation as at B, forming angles of 45 degrees. In its actual projection it makes an angle a little less than 35 degrees, 16 minutes with the plane on which the cube is resting.

In Figure 40 we have developed the shadow of a point in space upon a plane. On the left is seen the plan, the vertical edge of the plane of the shadow, and the point. On the right is the elevation, showing the plane and the point in space. The ray of light surrounding the point will intercept the plane

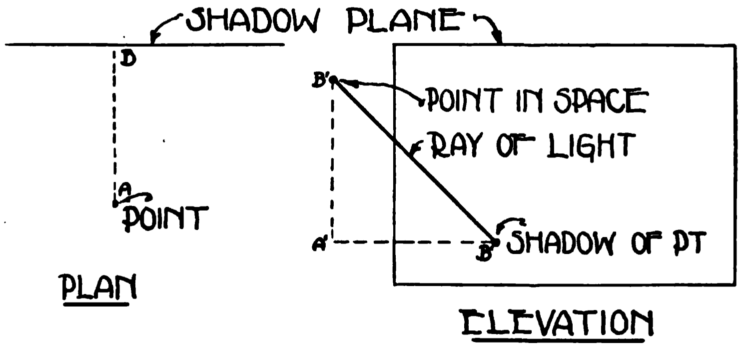


FIGURE 40.

at B—a point as far down and to the right as the given point is from the plane, that is, AB is equal to $A'B'$.

The shadow of a line is the composite shadow of the points composing the line. In Figure 41 we have a horizontal line parallel to the plane of the shadow, the plan giving its distance from the plane. Its shadow is easily obtained by determining the shadows of the points at the extremities, and connecting them. If the line were not straight, the shadow would be determined by casting the shadow of any number of points on the line, and connecting them, remembering that

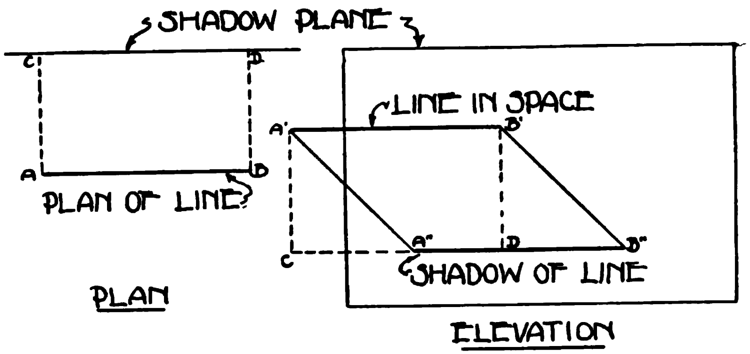


FIGURE 41.

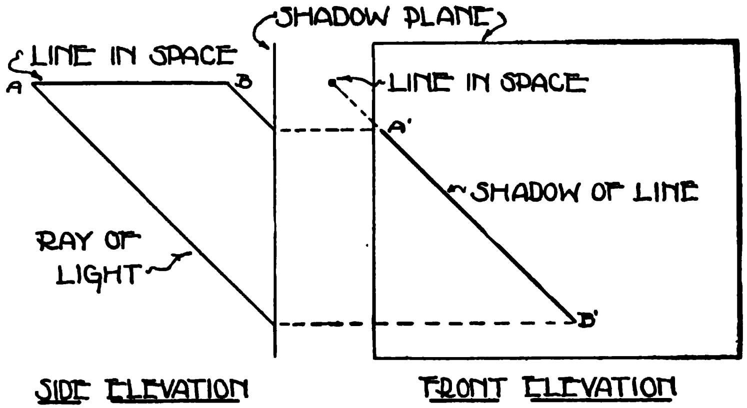


FIGURE 43.

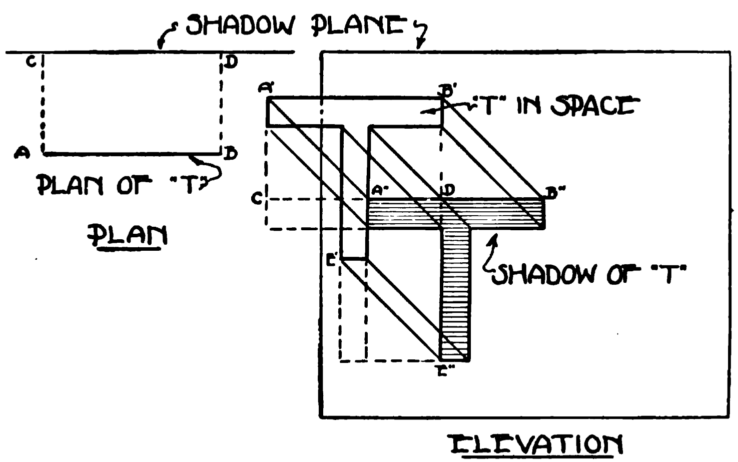


FIGURE 42.

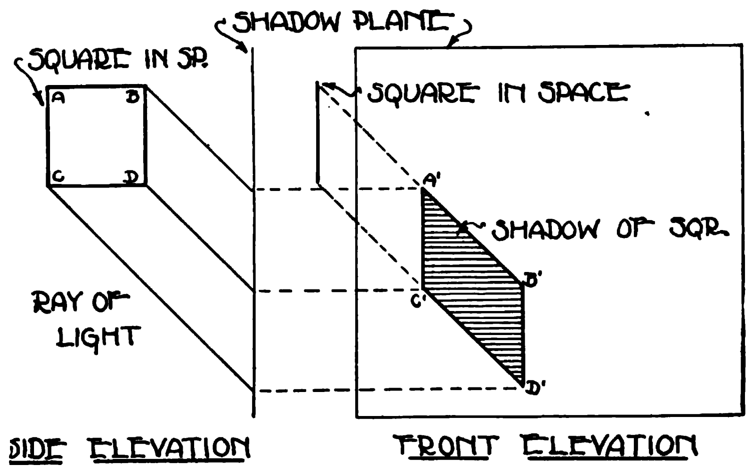


FIGURE 44.

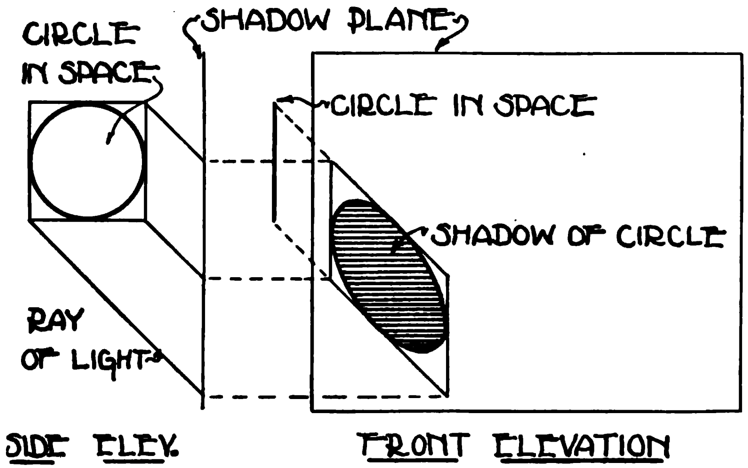


FIGURE 45.

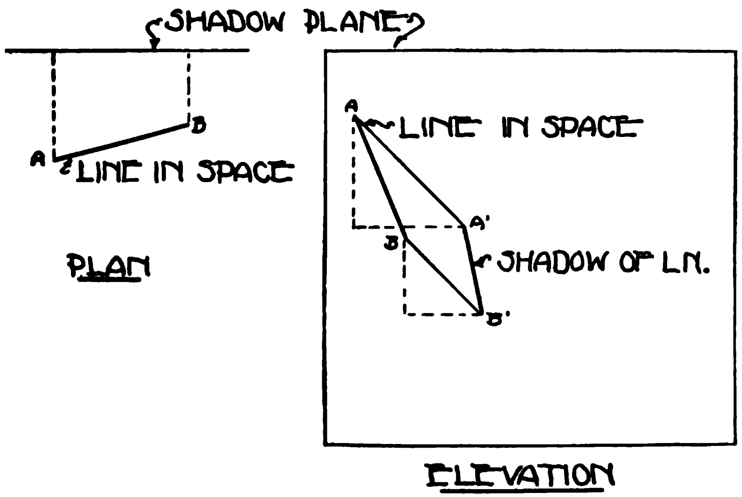


FIGURE 46.

the shadow of the points on the plane will be as far down and to the right as the points are from the plane.

A "T" would cast a shadow as shown in Figure 42. It is developed by casting the shadows of the points of intersection and connecting them.

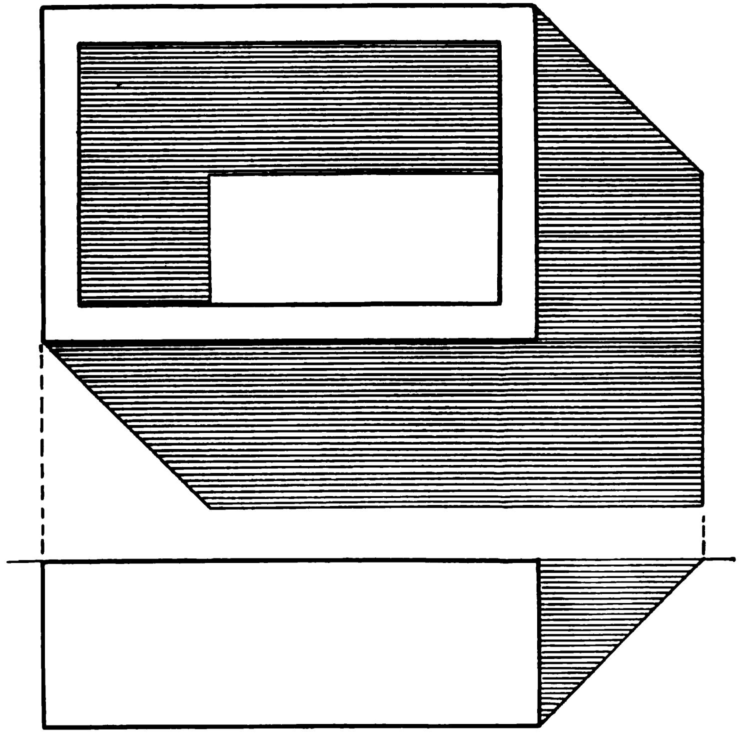


FIGURE 47.

A line that is perpendicular to the plane of the shadow will cast a shadow at an angle of 45 degrees—always. Figure 43 is an illustration of this rule.

A plane figure, such as the square in Figure 44 perpendic-

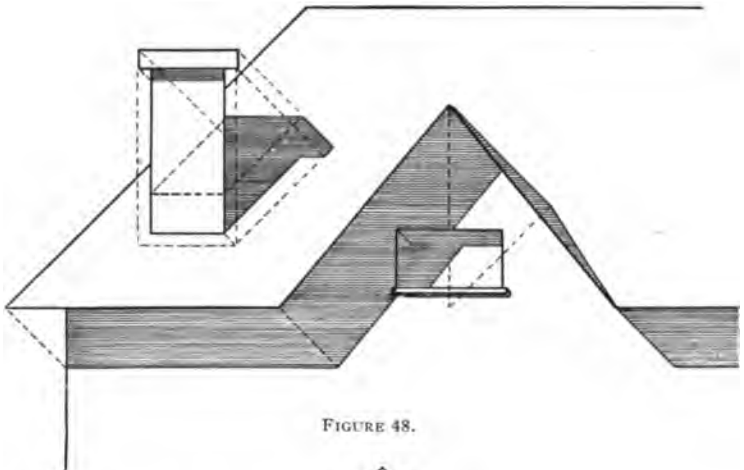


FIGURE 48.

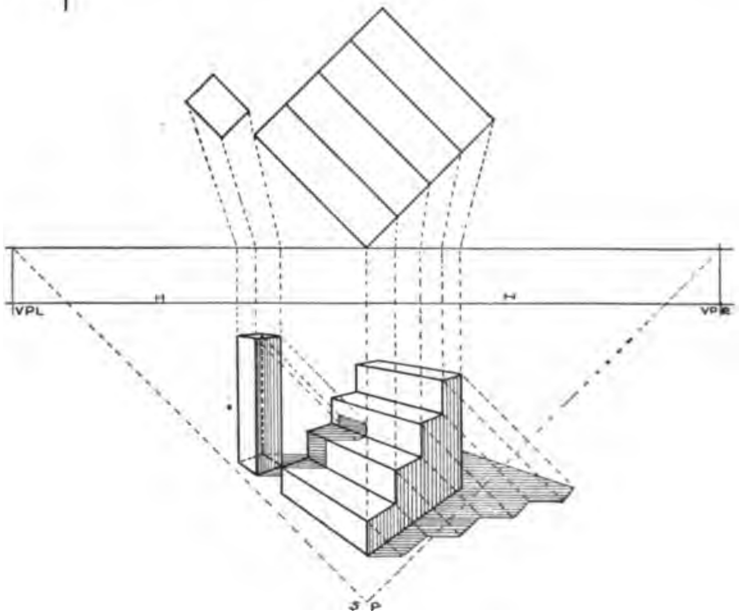


FIGURE 49.

ular to the plane of the shadow, will cast a shadow as shown. Sides AB and CD, being perpendicular to the plane, will cast shadows at an angle of 45 degrees, while sides AC and BD, being parallel to the plane, will cast them as vertical lines.

The shadow of a circle is cast by enclosing the circle in a square, and obtaining its shadow. An oval is then drawn tangent to the sides of the shadow, which will form the shadow of the circle. Figure 45 illustrates this point.

A straight line that is neither perpendicular nor parallel to the plane of the shadow will cast a shadow as diagramed in Figure 46. The shadows of the points composing the ends of the lines are cast and connected, forming the shadow of the line.

An application of the foregoing principles is found in Figure 47. It represents an open box, resting on a long edge with the open face toward the observer. The upper view, then, is the elevation, and the lower, the plan. The shadows in the elevation are as far down and to the right as the box is deep—inside and out.

Figure 48 illustrates a section of a house in elevation, and shows how shadows may be developed without the use of the plan. Where projections on the side and front are the same, as in the chimney cap and the cornice, a 45 degree line will give the depth of the shadow. Since the edges of the chimney are perpendicular lines, their shadow on the roof will parallel the slope of the roof. Notice in the window opening, that the shaddow of the cornice moves to the right, and on the sill to the left, as the first is a depression, and the second, an elevation.

Figure 49 illustrates the shadows cast in perspective. The general theory is exactly the same, as a careful study of the figure will reveal.

The student of shades and shadows can gain a great deal of practical information by carefully observing the shadow phenomenon as it occurs in nature. As you pass along the street

on a bright day, notice the character of the shadows cast by the sun on the adjacent buildings. The depth of the shadow —the effect on raised and depressed portions, etc. In this manner, an excellent working knowledge of shades and shadows can be obtained, which will prove invaluable when casting them in actual practice.

On architect's perspectives, usually, most of the shadows are "faked." That is, the draftsman knows the theory—how they would appear if actually developed—and, rather than take the time necessary to cast them exactly, he will put them in direct, as it is only the broad effect he is after.

The student will do well at this point to study carefully the shadows developed in the next chapter on rendering.

REFERENCES

C. F. Edminster—"Architectural Drawing."

American School of Correspondence—"Shades and Shadows."

To the Teacher: Your students' plates on shades and shadows, if you care to go into the theory, should be drawn up from your original problems. The problems should be based upon the text matter, but not copied. The main shadows on the perspective drawing of the building project can be accurately cast, but some freedom should be allowed in estimating the depth of shadow in the details.

CHAPTER XIII

RENDERING

To render a drawing—elevation, plan, or perspective—successfully, requires either a natural gift or a great deal of practice. It is a subject properly given to the university or higher technical school. Some high school students can attain it, and, as their perspectives require it, we will consider it here but rather briefly, and shorn of all technicalities.

Methods of Rendering. Drawings can be rendered in various ways—pencil, pen and ink, and water color.

After the perspective, or elevation, has been carefully drawn, and the shadows laid in *in outline*, it is ready to render. Shadows on perspectives can be more easily determined if they are cast first on the elevations, and then applied to the perspective. If the drawing is much soiled, a careful rubbing with rather dry bread will put it into condition.

Rendering in Pencil. Rendering in pencil is, perhaps, the most simple. Use a sharp BB pencil, and proceed with firm, short lines. In appearance, the pencil rendering will resemble the pen and ink, as illustrated in Figures 50, 51, 52, 53 and 54. Only the principal shadows should be put in, and no flat shading should be attempted—single lines only. When finished, spray the drawing with a thin coat of shellac by means of an atomizer, as with charcoal drawings. The original drawing on soft paper can be rendered in pencil, but it will be too soiled and too much "gone over" for any of the other methods.

Rendering in Pen and Ink. When rendering with pen and ink, the drawing should be penciled upon hard surface Bristol board or Whatman's hot pressed paper, as a soft drawing paper is likely to catch the pen point and spatter the ink.

Use a rather heavy pen. An Esterbrook No. 14, is good, or a Gillott No. 404. Too fine a pen will make a "scratchy," unsatisfactory drawing.

Before inking a line, study the character of lines on a well rendered drawing. Figure 50 will serve as an example. A slight curve is suggested for short lines, and a broken line for long ones. A slight quaver, such as would result if the hand trembled, is good, if not exaggerated too much. The lines in a shadow should be a little heavier at the lower end, attained by a slight pressure of the pen. Use a very free method—not cramped and restricted. Keep the corners clear, and do not detract from the appearance of the building by adding unnecessary details in the form of trees, etc. Of course a little of this accessory setting is necessary, but mountain peaks and Nuremberg trees, scattered around in great confusion, very often spoil the whole effect.

Figure 52 is a simple drawing neatly rendered, and can well be used as a model.

In Figure 51 the effect of winter is attained by a careful application of spatter work and clear places.

Notice the depth of shadow in Figure 54. This is to be desired, if carefully applied, as the three distinct values—white, gray, and black, are usually found on a well rendered drawing.

Figure 53 suggests a house of brick by means of horizontal lines. The clouds in this drawing are excellent, and may well be studied with care.

Rendering in Color. A wash drawing in shades of one color, or in various colors, is, perhaps, the most difficult of attainment. It should not be attempted upon the original drawing, as the surface of the paper will be soiled and broken; but this drawing, with the shadows cast, should be transferred to a clean sheet of water color paper. This paper should be stretched in the usual manner, and, when dry, the drawing is traced upon it. This is accomplished by the "rubbing method."

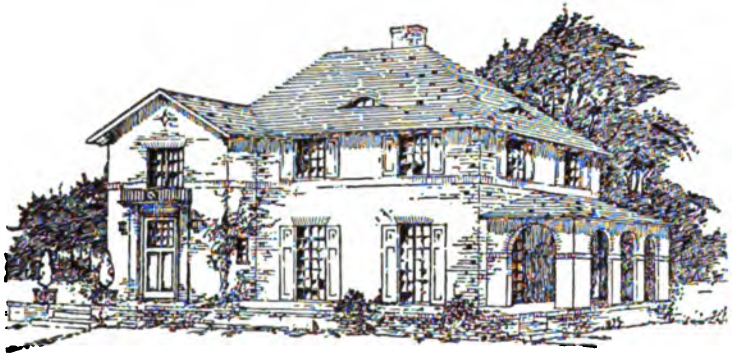


Figure 50.

Figure 52.

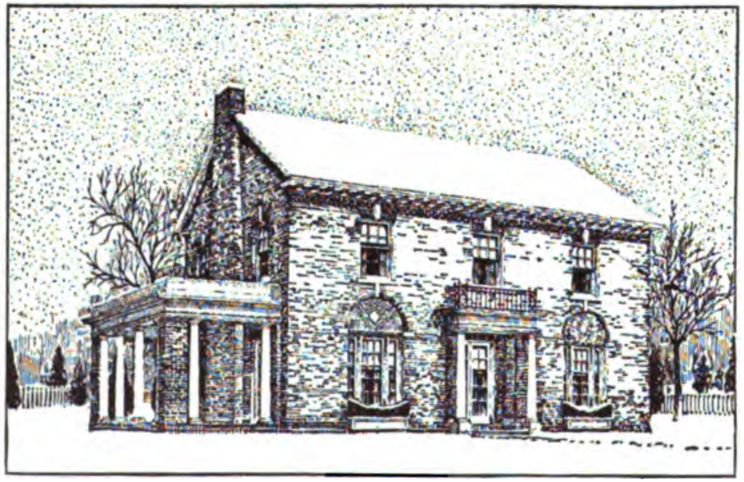


Figure 51.

Figure 53.

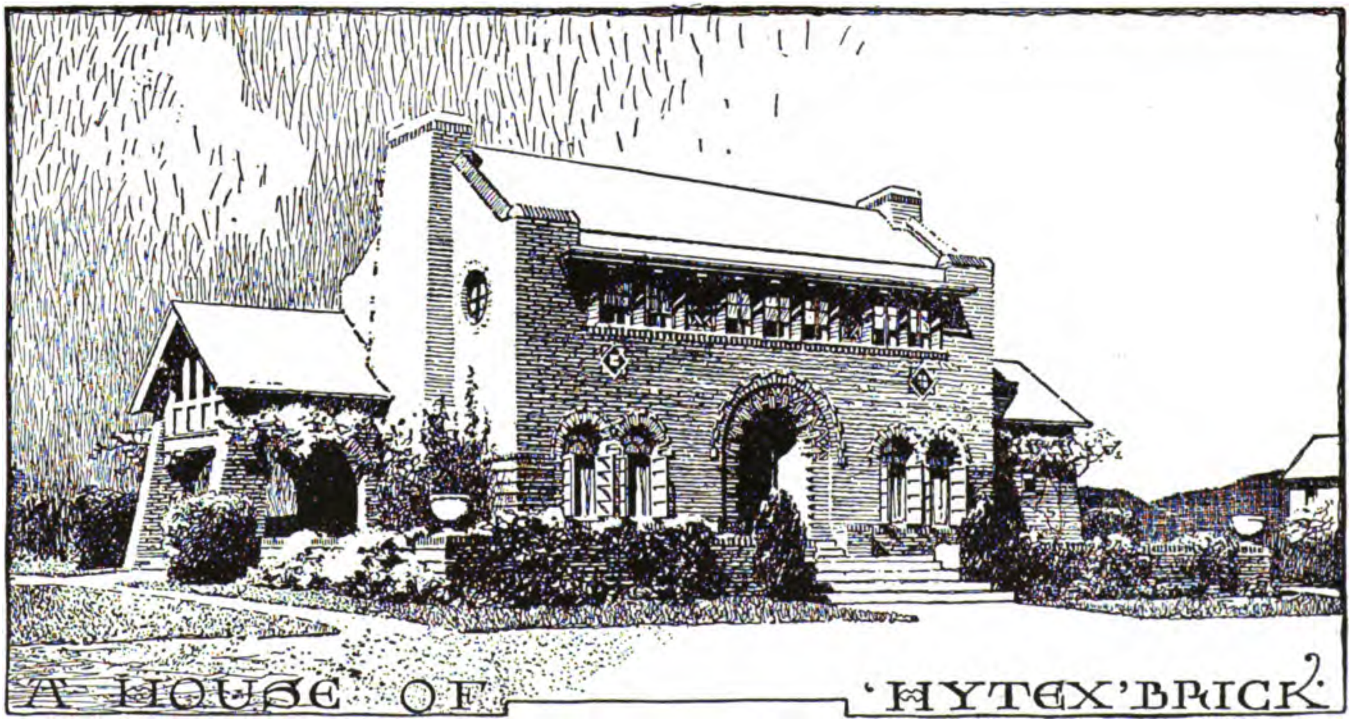


FIGURE 54.

Over the original drawing tack a sheet of tracing paper. With a sharp pencil—BB or a little harder—carefully go over the outline of the drawing. Turn this tracing over, and retrace it on the other side. Turn back again and tack it firmly over the drawing paper upon which the rendering is to be made, and with some smooth edged object—the end of an ivory handled ruling pen will do—rub lightly but carefully over the lines. If this rubbing has a tendency to buckle or tear the tracing, place a small piece of tracing cloth between the instrument and the paper, but be very sure that neither the cloth nor the tracing move.

When the tracing has been removed, your rubbing on the drawing paper is ready to render.

First, ink mechanically, using a very fine line that will almost disappear when rendered, inking only the lines that express the sharp edges separating the different surfaces. The shadows should be left in pencil. Make erasures unnecessary by inking very carefully. When all ink has dried, wash the drawing with clear water and a soft sponge, to remove superfluous ink and leave the drawing more subdued.

Have everything ready before applying any color—clean cakes of paints, plenty of clear water, camel's hair brushes of various sizes, clean blotters, cloths, and sponge. You can not leave your work to hunt these things after you have started a wash.

Tip the board slightly so that the washes will run down, and mix up a good amount of your prevailing colors in separate dishes. Do not use the clear primary colors, but tone them down somewhat.

Start at the top and carry down a blue sky to your building. It should be darker at the top, and almost clear near the horizon. Use a large brush, and add water to it as you work down. When you have reached the sky line, soak up the surplus with the clean blotters.

Next apply a tint over the entire building—a light yellow or cream color being suggested. Over this lay your shadows—washes of purple over the shaded portions—and additional washes where they are darker.

A tint of green over the trees and grass, and additional washes for emphasis and shadow, will bring out these features.

Finally, careful "dabbing" for the little details will complete the rendering.

This hurried description of one method may, or may not, bring to the student a clear conception. Words alone can not

FIGURE 55.

make an artist. If the student has the natural ability, his rendering will show it—if not, it will appear stiff and mechanical.

There are some principles that must be observed in rendering, and a careful study of them may be of great help.

For light and dark shades, apply several washes of one color, rather than a heavy color all at one time.

Do not let a wash dry after once starting it. If mistakes are made, carry it on to completion, and rectify them later.

Do not allow the brush to become dry while applying a

FIGURE 56.

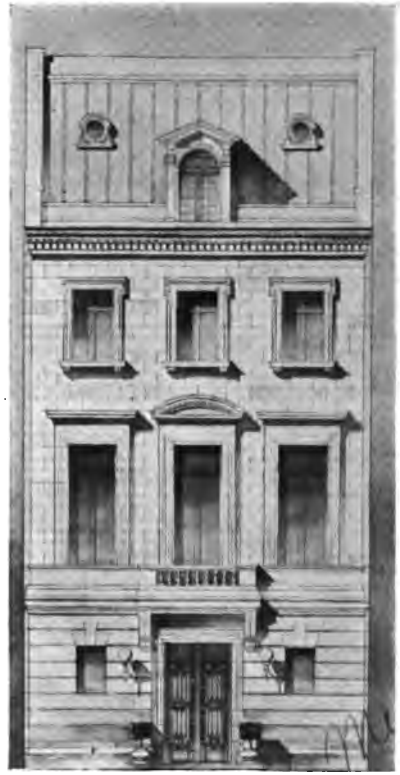


FIGURE 57.

FIGURE 58

wash, as the next brushful which will carry on the color will cause a streaked effect.

Do not attempt to add color to any portion that has dried, as the soft blending will be destroyed.

If blotches or errors are to be removed, sop them with water, and when the color has been loosened, take up with a clean blotter. If the color has run past a line where it should have stopped, a stiff Bristol brush and clean water will soften up the paint so that it can be removed with a blotter. Several applications may be necessary before the color is entirely gone.

Figure 55 is reproduced from a rendered perspective of a monument, and illustrates tone values. Figure 56 is the rendered elevation of the same.

Figure 57 illustrates a rendered elevation of an apartment, the shadows on which are especially interesting.

FIGURE 59

In Figures 58 and 59 will be noted the excellent treatment of shadows, shades, and tone values upon small details.

The frontispiece will suggest a method of rendering perspectives in color. This, together with a careful study of the Figures, should give the student a really practical conception of the requirements of rendering.

REFERENCES

F. F. Frederick—"Wash Method of Handling Water Color."
Hydraulic Press Brick Co.—"The Hytex Home of Moderate Cost."
National Fire-Proofing Co.—"A Book of House Designs."
Rogers and Manson—"A House of Brick."
D. A. Gregg—"Rendering in Pen and Ink."
T. E. French—"Engineering Drawing."

To the Teacher: Before rendering in color, it is well to have the students practice the laying of washes and shades on a separate piece of paper in small rectangles about 2" by 3". If you can secure a few well rendered drawings from a local architect to hang in your drawing room, their suggestion will be of great value to the student.

CHAPTER XIV

SPECIFICATIONS AND ESTIMATES

It is very evident that the plans can not contain *all* the information necessary to properly construct the building; hence a set of *specifications* is needed. Upon them, any information—especially concerning the quality of the work—that is needed to protect the owner, must be stated. They supplement the plans and are just as necessary to the proper completion of the job. Some architects will get out one set of specifications for the entire project, while others will have separate sheets for plumbing, painting, heating, etc. This latter method is to be recommended where there is a general contract let to one man, who will sublet to others.

A better knowledge of specifications can be gained by studying a set than from any explanation; hence we will present one below.

S P E C I F I C A T I O N S

O F

work to be done and material to be furnished in__________ building, for__________of __________ of __________ St. to be done in accordance with plans, specifications and details prepared by__________ Architect, of__________who will also superintend the construction of the building, and all questions arising must be submitted to him. His decision shall be final.

NOTICE TO ALL CONTRACTORS

WHAT HOLDS. All contractors employed on this work should be sure they understand the plans and all specifications, for each one will be bound by all things appearing therein, whether under one particular head or not, that in any way affects him.

No subcontracting will be allowed, unless by expressed consent of the architect, and all such contracts shall be entered into in the architect's office and witnessed by him.

ALTERATIONS. At any time the architect, directed by the owner, may require any alteration, addition, or omission from the contract, and the same shall not affect the validity of the contract, but the price of such work shall be added to, or deducted from, the contract price, as the case may be; but extra work shall be paid for only when the price has been agreed upon and affixed to the order given by the architect in writing and countersigned by the owner previous to the performance of same. Such order for work must be produced and surrendered or no payment for such work will be made.

SUPPLYING LABOR, ETC. Should the contractor at any time during the progress of the work refuse or neglect to supply a sufficiency of materials or workmen, the architect shall have power to provide materials and workmen after three days' notice having been given in writing to furnish said material and workmen. In case of non-compliance, the expense arising from such action shall be forfeited, and if necessary the work relet. The materials and implements on the premises shall hereby become forfeited and sold, if necessary, to finish the work.

BOND. Upon demand, all contractors are to provide a bond of sufficient amount, with ample sureties for the completion of the contract, and for the delivering of the

building free from liens within the time specified in the contract, or in case of failure to pay such forfeiture as is therein mentioned. He shall in all cases produce receipts in full for all labor and materials, before final settlement, and shall secure the owner against liens, being put on the building as may be required.

DUTIES. The contractors are to give their personal supervision to the work; to furnish all labor and material necessary to make a complete and workmanlike job, according to the drawings and the spirit of the specifications, to the entire satisfaction of the architect, who shall have full power to reject all work and materials not the best of the kind specified, and should such material be introduced, it must be removed and replaced entirely at the contractor's expense.

These specifications and the drawings referred to are intended to include everything requisite and necessary to the proper and entire finishing of the job, notwithstanding every item necessarily required by the work is not particularly mentioned. All the work when finished to be delivered up perfect, complete, and undamaged in every particular.

RESPONSIBILITIES. The contractors are to be responsible for all violation of law; to obtain all licenses; and to pay all proper fees and charges of all kinds arising out of and necessary to the constructing and carrying out of all work. They are to make good all damages to adjoining property, keep up lights as required, construct proper public safeguards, perfectly reinstate pavements, etc., to the satisfaction of the architect. The contractors will also be wholly responsible for all damage suits arising out of and connected with the work, and also remove all rubbish and waste from off the premises, leaving the building broom clean at completion.

DELIVERING UP OF WORK. Each contractor shall deliver up his work in first-class style to the one following him, clean and perfect, as may be, and within the time specified in the contract. Each craftsman must not only take care to thoroughly protect his work, but also not to damage in any way the work of any other. Workmen or subcontractors, if there be any, shall be each held to do his proper part of the above, and to do his work with all due regard to the rights and convenience of others both as to time and method.

INSPECTION. The whole of the work to be inspected as it goes on, and accepted by owner and architect, before a final settlement is made.

GENERAL CONDITIONS

DETAILS. The details are intended to be final concerning all sizes, lines, etc., set forth, and are not to be deviated from without written directions from the architect; but figuring and notes are more authoritive than scale sizes, not only in the details, but in all drawings; otherwise, sizes shall be accurately scaled and followed.

SPECIFICATIONS. The specifications are to be thoroughly understood, and the spirit of them rigidly followed. If the plans and specifications contradict each other, the attention of the architect shall be drawn to the fact and his decision obtained before the work is undertaken. For all delays and extra work occasioned by such mistakes, contradictions and omissions, real or imaginary, the contractor shall be considered responsible for not having them explained or corrected.

DRAWINGS. The drawings and specifications are intended to be used conjointly, so

that anything shown in one shall be executed the same as if shown in both of them. The colors used indicate the same materials as they usually do in architectural drawings.

ARCHITECT'S PROPERTY. These plans, specifications and details are the personal property of the architect who allows them to be used on the building mentioned above. When completed, plans, etc., shall be returned to him in as good condition as possible. No copies of any part of them whatever are to be retained under any circumstances. Failure to comply with this section gives the architect the right to lawfully proceed against the offending parties, and the owner will keep twenty-five dollars until all plans and specifications and details are returned to said architect.

EXCAVATION. Excavate for all basement footings for walls, piers, cellar ways, porch piers, complete. Excavations will be made level and of such width as will allow for all walls and piers to be built without being laid to earth bank. Excavations to be made to firm and solid soil. If there has been any old basement or cistern on this lot, excavations must go to bottom of such old basement or cistern and walls must be built to firm and solid soil with concrete footings under all walls, as shown in the details. Excavations must be made for all chimney, cross wall, and outside wall footings. Basement must be 7' 0" clear from under side of joist to top of concrete floor.

CONCRETE. Build concrete footings 1' thick, and 6" wider than thickness of wall, the concrete under chimneys will be 6" wider than brick work for chimneys, and 12" deep. All footings for this work will be made of Portland cement, one part, and five of good coarse clean gravel; same must be well mixed and well tamped down and all must be laid level and plumb, and all concrete to be put into forms made out of 2" plank.

FOUNDATION WALLS. Foundation up to grade line will be 12" thick. All foundation walls and footings will be laid in forms of 2" plank, well stayed and braced so as to make a plumb and straight wall. This foundation will be made of Portland cement, one part, and five parts of good clean coarse gravel, to be placed in 6" layers, and well tamped. On top of this foundation place concrete blocks, 3 courses, these concrete blocks must be laid level and plumb, and all laid to a true line.

CHIMNEYS AND PORCH PIERS. Chimneys and porch piers must be constructed of good, hard, well burnt red brick, and all outside brick work must be selected and of an even color and uniform in size; to be laid in cement mortar, colored red. Chimneys must be built plumb and level, and free from any obstructions. All joints must be struck smooth on the inside and there will be no flues allowed to be plastered in any part of them. There will be a clean-out in the basement for all flues. And these flues are to receive heavy galvanized stopper for same. Chimney will be capped with 3" cement cap, made on the ground and left to season, and after same is thoroughly seasoned, will be rock-faced and applied to chimney with cement mortar bond.

TILE IN FOUNDATION. Place tile in foundation for all pipes, such as gas, water and sewer tile underneath footings for sewer.

TIMBERS, HEADERS AND TRIMMERS. All timbers, including girders, trimmers, truss beams, studdings, etc., shall be made of sound yellow pine surfaced on one side and one edge, except timbers which are thicker than 2 inches, which are to be surfaced on four sides, and free from defects which are liable to

weaken the timber, and of the grade and kind specified in the attached bill of materials. Same to be well seasoned. All timbers must be prepared, framed and constructed according to the attached drawings and detail sections. All rafters to be notched $1\frac{5}{8}$ inches on to plates and well spiked. Attic collar beams 2x4 inches to be placed on every rafter. All outside studding to be 2x4 inches, sized, and partition studding to be 2x4 inches, sized. Studs and headers to be doubled on corners and on all openings around doors and windows, also doubled for plate. All floor joists, studding and rafters to be set 16 inches from center to center, to be well nailed in the best manner. Joists to be sized and laid crown side up. Wall sills or plate on concrete block walls to be sized as shown in details. Joists around outside porches, to be doubled and all to be well spiked in their respective places; also the joists under partitions to be doubled. Lap each joist by each other the full width of the girder and spike well together and to the girder. Put suitable supports between joists in the exact center of each room to secure hooks for hanging lamps or chandeliers.

ROOFING BOARDS. Cover all roofs with No. 2 roofing boards surfaced on two sides, as described in the attached bill of materials; same to be laid not to exceed 1 inch apart for shingles. All to be well nailed to each rafter with 8d nails.

SHINGLES. All roofs to be shingled with the best grade of "A" cedar shingles, laid $4\frac{1}{2}$ inches to the weather and break joints not less than $1\frac{1}{2}$ inches, all to be well nailed with 3d galvanized nails.

BRIDGING. Each tier of floor joists shall have one row of 1x2-inch double cross bridging in a continuous row, from one end to the other, perfectly straight; to be cut to shape and nailed at each end with two 8d nails.

WINDOW AND DOOR FRAMES. Assemble and put into place all window and door frames where shown on plans, same to be set up square and true and securely nailed to studding. Outside door jams to be furnished $1\frac{3}{8}$ inches thick and rabbeted for outside doors. All outside casings to be furnished $1\frac{1}{8}$ inches thick. All inside door jambs to be furnished $\frac{7}{8}$ inch thick, of the same kind of wood that each room is finished with. All window and sash frames to be furnished with pulley stiles 13-16 inch thick.

SHEATHING AND FLOOR LINING. Enclose the entire building with No. 2 D. & M. pine sheathing boards, same to be close and properly laid and well nailed to each studding with 8d common nails. Cover first floor with No. 2 1-inch pine boards, surfaced on two sides, laid diagonally close together and securely nailed to each joist with 8d common nails.

SIDING. Side the building above the belt course and rear addition (except openings) with clear cypress bevel siding, $\frac{1}{2}$x$3\frac{1}{2}$ inches, making close joints against casing, corner boards, water table, etc. All siding to be straight lines and spaced with top and bottom of all windows and securely nailed to each studding with 6d nails, and primed as the work progresses.

CORNICE. Build cornice around entire house, porches, and dormers as shown in detail, using "C" cypress free from knots and sappy places for frieze, and Y. P. beaded ceiling for plancer. Mouldings of white pine, all to be well nailed and fitted and primed as soon as put up.

TINWORK. All down spouts to be well secured with hooks and to extend down to water

table and finished with an elbow to turn water from foundation. All eaves troughs to be placed on roof as shown on the elevations and to be laid in the best workmanlike manner, with sufficient fall to draw the water to outlets. All flashings around chimney must be absolutely watertight, all end flashings where porch roofs join the house must be flashed with galvanized steel as specified in the attached bill of materials. All ridging on roofs to be covered with V angle galvanized ridge. Place wire screens over all openings for down spouts.

BUILDING PAPER. Cover all sheathing boards above belt course with 50-pound red rosin sized sheathing paper, well lapped.

CLOSETS. Each closet to have 3-inch plain strips extending around the closet on inside to which fasten clothes hooks, placed 14 inches apart, also shelves 12 inches wide, well secured with a 2-inch strip.

GROUNDS AROUND OPENINGS. Put in grounds for finish of all base, casing, etc., before plastering, grounds to be the proper size and well nailed.

LATHING. Lath all outside and partition walls and ceiling, except basement and attic, with No. 1 pine lath. Break joints every 16 inches and lath not to exceed $\frac{3}{8}$ inch apart on walls and between $\frac{3}{8}$ inch and $\frac{1}{2}$ inch apart on ceilings, each lath to be nailed with 3d fine lathing nails. All corners to be made solid before nailing; there must not be any lathing through angles from one room to another. Lath must not stop and form a long vertical joint, nor can any lath be put on vertically to finish out two corners or angles. All lathing to run down to floor behind base.

PLASTERING. Plaster all lathed walls, ceilings and chimney surfaces in plastered rooms with two coats of plaster. The first coat to be composed of good brown hair mortar. When preparing the brown mortar, the best grade of sharp sand, live quicklime and a good grade of hair well picked apart are to be used. Before mixing the lime, hair and sand, the lime must be allowed to stand eight days after slaking. When mixing the sand, lime and hair, work in as much sand and such proportions of hair as can be used and still enable the plasterer to apply same on the walls and ceilings. Allow the first coat to become thoroughly dry, then apply a coat of plaster Paris hard finish. Float, straight edge and smooth plastered walls and make all corners square and plumb. Do all necessary patching and pointing after the work is finished. Contractor is to furnish necessary heating apparatus and fuel and maintain fires for drying plaster and properly carrying on any other part of the work in this building.

WAINSCOTING. The bathroom shall have wainscoting all around walls 4 feet 6 inches high; same to be applied on plaster and to consist of the best grade of cement for that purpose mixed according to the manufacturer's directions and to be blocked off in imitation of tiles and enameled white.

INSIDE FINISH. There shall be no floors finished up on this building before plastering is thoroughly dry and all plastering and waste is removed from same. All finish throughout the entire house to be No. 1, yellow pine.

DOORS. All doors shall be five cross panel doors and doors shall be of such size as marked on plans, No. 2 doors. Front doors shall be $1\frac{3}{4}$" thick and a polished plate beveled glass in same.

CASINGS. Casings for this job shall be a 4" casing, edges rounded and a three member head casing. Base shall be a two member. This finish will be shown by detail.

FLOORS. First and second floors of this building shall be yellow pine $\frac{7}{8}$"x$3\frac{1}{4}$" face. This floor must be strictly No. 1, must not show any black spots in same, must be dressed and smoothed and must not be laid until plaster is thoroughly dry and all other finish is on. If any of these floors squeak by reason of not being sufficiently nailed, the same shall have to be taken up and relaid. All finish throughout house will be made and placed according to details. All base must be housed into base blocks and cope all base in corners. All joints must be cut to fit and must show nailing as little as possible.

STAIRS. All stairs shall be built as shown on plans; steps shall be made out of $1\frac{1}{8}$" lumber; rises $\frac{7}{8}$" thick and rise to stairs will be not more than 7". There will be cove under nosings of stairs, and all these stairs will have edge of steps rounded, and all must be put in place after plastering is finished, and after the same is placed, they must be protected with good heavy paper, for the same must be left in a perfect state at completion of job.

GLASS. Glass for front door shall be polished plate beveled glass. Glass in basement shall be single strength A. A. American glass. Glass for first and second floors shall be double strength A. A. American glass. All this glass must be free from all blurs and blemishes and other defects. All glass must be well puttied and bradded and all sash must be painted or oiled before being brought to building.

SASH. All sash shall be white pine, well seasoned sash, $1\frac{3}{8}$" thick; all sash shall be hung with weights and braided cotton sash cord, and be hung so they will balance accurately.

HARDWARE. Basement hardware shall be black Japan steel butts and rim locks with black jet knobs. Hardware for windows in basement shall be $2\frac{1}{2}$"x$2\frac{1}{2}$" steel fast pinned butts, hung at top with hook and eye to hold same open and a good strong fastener to hold same closed when closed.

FRONT ENTRANCE DOOR. A. B. 652 Lock Sets, B. F.

INSIDE DOORS AND REAR ENTRANCE DOORS. A. B. 253 B. F. Lock Sets.

DOUBLE ACTING DOORS. 5171 Chicago Floor Hinges and A. B. 835 B. F. Push Plates.

WINDOWS. A. B. 1887 B. F. Sash Lifts and A. B. Sash Locks.

PAINTING. Paint all outside woodwork two coats of lead and linseed oil, and such color as the owner may direct. All galvanized iron work will be painted with two coats of Graphite paint. All outside doors and ceilings will have three coats of Spar Varnish, natural finish, and all inside work will have three coats of inside varnish, carefully rubbed. All wood work to be thoroughly puttied and sanded, and all defects covered, and left in a thorough and workmanlike manner. All saps and knots both inside and outside shall be covered with a good coat of shellac, smoothed down, and this is to be done before any paint is put on.

CONCLUSION. These plans and specifications are intended to include everything necessary for the proper completion of this job, notwithstanding every item may not be particularly mentioned in specifications or shown on plans; but the contractor shall have to complete this job without any extra expense to owner and if there is anything that the contractor sees that has been omitted or not fully explained he must mention the same to architect and same will be explained to him before contract is signed. There will be no allowance for not having these things explained or corrected.

Estimating. Estimating is more in the province of the carpenter and contractor than of the architectural draftsman, but a brief discussion of it here will not be amiss. There are two methods of estimating—the exact, and the cubage. The former is a complete study in itself, and makes necessary a knowledge of current material prices in all divisions of the work, and the varying cost for labor.

The cubage method is based upon the cubic feet in the building, and is the result of many averages. It is not reliable, excepting for a very restricted class of buildings with which the estimator has had a certain amount of experience. Differences in design, inside finish, outside trim, built-in conveniences, etc., make it impossible to give figures that will stand in all cases. But for the student's estimating, where exact figures are not a matter of profit and loss, the following table can be used.

Taking the cubic feet in the entire house from the basement floor to half the height of the roof, the following figures for the types of building indicated may be regarded as a fair average.

Frame building covered with narrow siding, 16c per cubic foot.

Frame building covered with metal lath and stucco, 17c per cubic foot.

Frame building with brick veneer, $20.00 facing brick and stone trimmings, 19c per cubic foot.

Brick building of ordinary soft brick and stone sills, 19c per cubic foot.

Brick building faced with Hytex or other good facing brick and stone trimmings, 22c per cubic foot.

Cement block building, 20c per cubic foot.

REFERENCES

Greenberg and Howe—"Architectural Drafting."
Wm. Arthur—"The New Building Estimator."
Chas. E. White—"Successful Houses and How to Build Them."
A. W. Joslin—"Estimating the Cost of Buildings."

CHAPTER XV

PLUMBING, HEATING, AND VENTILATION

No matter how well planned and built a home may be, it will always prove unsatisfactory unless equipped with sanitary, efficient plumbing and a well installed heating plant. There was a time when these things were looked upon as conveniences—now they are classed with the necessities.

Sanitary plumbing means the proper disposal of waste, the circulation of clean air through the sewerage system, and the constant supply of hot and cold water to the fixtures.

Plate XXIX illustrates the sewerage and piping systems of the majority of American homes. Some homes are more elaborately equipped, especially in the matter of fixtures, but the average is well represented.

Sewerage System. For sewerage, a 4″ soil pipe extends from the basement, where it is connected with the sewer main, cesspool, or septic tank, up through the roof. This is the main carrier of waste and one means of sewerage ventilation. It is made of cast-iron, the connections being closed with oakum and molten lead, well calked so as to provide a joint absolutely water and gas tight.

Into the soil pipe run all drains from the various fixtures. Between each fixture and the soil pipe a "trap" is placed which is ventilated by a 2″ pipe connecting with the main stack above the highest fixture or it may be carried up separately through the roof. If there are any bends in the soil pipe, a "clean-out" is placed at each of them. The traps are usually of an "S" or "P" type. They are used as clean-outs, and as preventives against the seeping of sewer gas up into the house. An "S" trap, for example, holds water in the bottom of its curve, so there is no opening between the sewer and the fixture to allow the deadly sewer gas up into the rooms.

From the soil pipe to the sewer main a vitrified tile pipe with cemented joints is used. It should not begin until after the iron soil pipe has been extended past the wall line of the house, as a break in it under the house would be too dangerous. Often a "one way" trap is placed where the tile pipe connects with the iron, to prevent any "backing up" of the sewer main into the house. This sometimes occurs during floods, if the sewerage system of a city empties into a river.

In the country, where no sewerage disposal is provided, a septic tank is constructed. The sewer pipe leads down into it, as illustrated in Figure 60. It is made of concrete, and has two compartments. Entering at *A*, the clear liquid makes its way into *B*, and the solid particles settle. They are soon converted into liquids through bacterial action, and finally seep out into the ground through the outlet in compartment *B*. Usually several pipe lines are connected with this outlet, just under the surface of the ground. A tank such as this, for the average country home, will last for years without any attention; but, should it need cleaning out, covers are always provided.

Piping System. The right half of Plate XXIX illustrates the water pipe connections for both hot and cold water. From the street supply main, a ¾″ galvanized iron pipe enters the basement. It runs up through to the second floor bathroom, diminishing in size as its needed volume is decreased.

A connection from it enters the hot water boiler, which may be located in the kitchen, and connected to the water back in the range, or in the cellar where the water back in the furnace furnishes the heat. The latter is the usual city method.

As hot water always rises above cold, the water in the bottom of the tank is forced into the furnace coils, where it

is heated, passes back into the tank, and rises to the top, thus supplying a constant circulation until all the water is hot. Water, being drawn off through the fixtures, keeps its temperature down; but all boilers are tested for 200 to 250 pounds pressure, which is strong enough under ordinary circumstances to withstand this force.

As furnaces are not in use all the year around, separate

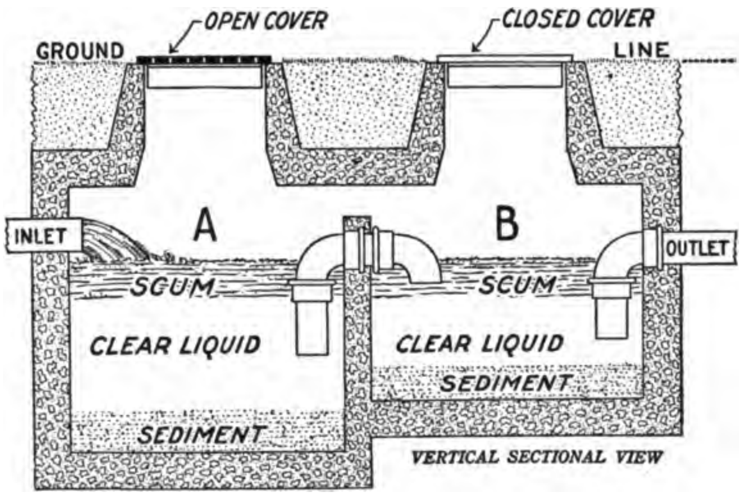


FIGURE 60

coal or gas heaters are usually connected to the tank, by the means of which hot water may be had in the summer time.

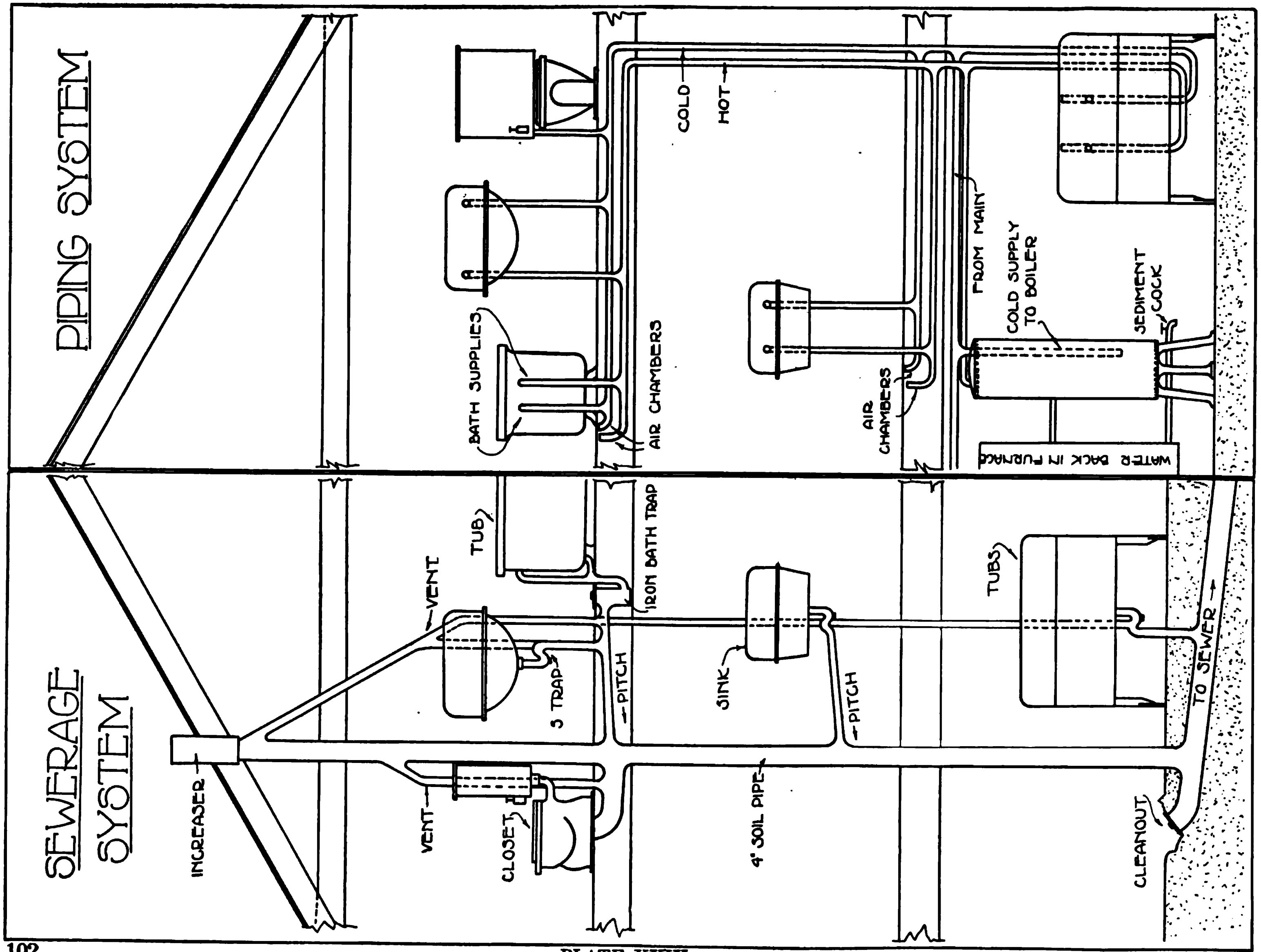
At the extremity of each water branch, an air chamber is placed. Its purpose is to form a cushion, so that when a faucet is opened, and the water starts to run at a high velocity, its sudden turning off causes the water to strike this cushion. If there were no air chambers, the water would soon put the faucets out of order.

Heating and Ventilation. Modern heating systems have been developed to a high degree of efficiency. Hot air furnaces, hot water and steam boilers, have been so greatly improved in recent years, that only in very rare cases are houses constructed that depend upon the old-fashioned stove for warmth.

Efficient heating apparatus is designed to perform the function of heating with economy. A system that gives off an abundance of heat with no economy of fuel is unworthy. The prevailing idea in the selection of a heating system should not only be first cost, but the possibility of securing *all* the heat out of the fuel consumed. Of course this ideal condition can not be realized, but the system that most closely approaches it should be given the preference.

Hot Air System. The great advantage which the hot air system has over other systems of heating is ventilation, especially when the system is operated with cold air taken in from the outside. When the plant is operated in this way the cost of fuel is greater, but the plant serves as a ventilating system as well as a heating system. A hot air plant is the most healthful system that can be installed. It, naturally, requires much fuel to heat air at zero temperature to a degree high enough for comfort, and for that reason most furnaces are installed with an inside cold air return, as shown in Plate XXX, the cold air being taken from some hall or open room where good circulation can be secured. Some contractors put a tee connection in the cold air duct, one branch to an inside cold air face, and another branch to the outside air. By the means of dampers, either face can be used—the inside during extremely cold weather and the outside at other times or whenever it is desired to ventilate thoroughly. This is a very good plan, as clear, fresh air can always be secured, whenever desired, by simply operating the dampers in the cold air duct.

The principle of the working of a warm air furnace can best be understood by imagining an ordinary heating stove, enclosed in a sheet iron casing, placed in the basement; a series of pipes connecting out of the top of this casing to carry the



PIPING SYSTEM
BATH SUPPLIES
AIR CHAMBERS
COLD
HOT
AIR CHAMBERS
FROM MAIN
COLD SUPPLY TO BOILER
SEDIMENT COCK
WATER BACK IN FURNACE
SEWERAGE SYSTEM
INCREASER
VENT
CLOSET
VENT
S TRAP
PITCH
TUB
IRON BATH TRAP
SINK
PITCH
4" SOIL PIPE
TUBS
TO SEWER
CLEANOUT

PLATE XXIX.

warm air to the different rooms that it is desired to heat; a large cold air supply pipe leading from one of the rooms or from the outside atmosphere, connecting to the bottom of this casing in which the stove is placed. The heat from the stove enclosed in the casing heats the air, and as the air becomes lighter it has an immediate tendency to rise to the top, the heavier cold air coming in at the bottom, forcing it out through the pipes leading to the different rooms, so that a constant circulation of air is maintained.

The hot air system is not quite as dependable where far off rooms are to be heated, especially rooms on the north side of the house, and it is not quite as economical in fuel consumption as a steam or hot water heating system; but in the matter of better ventilation, smaller first cost, more rapid heating, and simplicity of operation, it has the advantage over all the other systems.

When figuring the capacity of a hot air furnace, the following table may prove a convenience. These data are based upon the furnace of one manufacturer—each having tables that apply to their own product.

CAPACITIES OF HOT AIR FURNACES

Cubic Feet to Heat	Diam. of Fire Pot	Diam. of Grate	Diam. of Casing	Height of Casing
11,000	18½"	14"	32"	58"
16,000	21"	16½"	36"	59"
22,000	24"	18½"	40"	60"
31,000	26"	21½"	44"	61"
37,000	29"	22¼"	50"	64"

The figures above apply to houses well built and protected. If exposed on all sides, no storm windows and doors, or in extremely cold latitudes, add 10% to the cubic contents and select the furnace with next higher grate diameter.

One Pipe System of Steam Heating. The working principle of a steam heating system is very simple. The ordinary gravity system of steam heating, Plate XXXI, consists simply of a boiler, which is filled with water to within about 6" or 8" of the top—this space being left for steam. Out of the top of the boiler a pipe is carried straight up, to a point within 6" or 8" of the basement ceiling, where an elbow is put on, and the pipe carried around the basement with a gradual pitch downward being finally brought back to the boiler and connected into the bottom return inlet. This pipe is called the steam main, and from this main, connections are taken to supply steam to all the different radiators on the plant. When the fire is started in the boiler, the water becomes heated. Steam is generated and rises up into the steam main. As the steam expands, pressure is developed, and the air contained in the pipes and radiators is forced out through the air valves. When the hot steam strikes these valves, they close automatically by expansion. When the steam strikes the cold surface of the radiator and the pipes, it condenses into water, and gives up its heat. The system must be so designed that this water will flow back to the boiler by gravity, where it is boiled over again into steam, and the process repeated.

There is no water used up, the only loss being the small amount that escapes around the air valves. Whenever the water becomes low, as can be determined in the water glass, the feed cock is opened, and the system supplied. As a protection against the water's being forced back up into the return pipes by a sudden rise of pressure in the boiler, check valves are placed in the return pipes just before they are connected with the boiler. Care must be taken that these valves be placed so that the water can enter the boiler, but can not leave it. There is a safety valve set to blow off at 10 or 12 lbs. so that excessive steam pressure can not be developed. In addition to this valve, there is usually a fusible plug directly

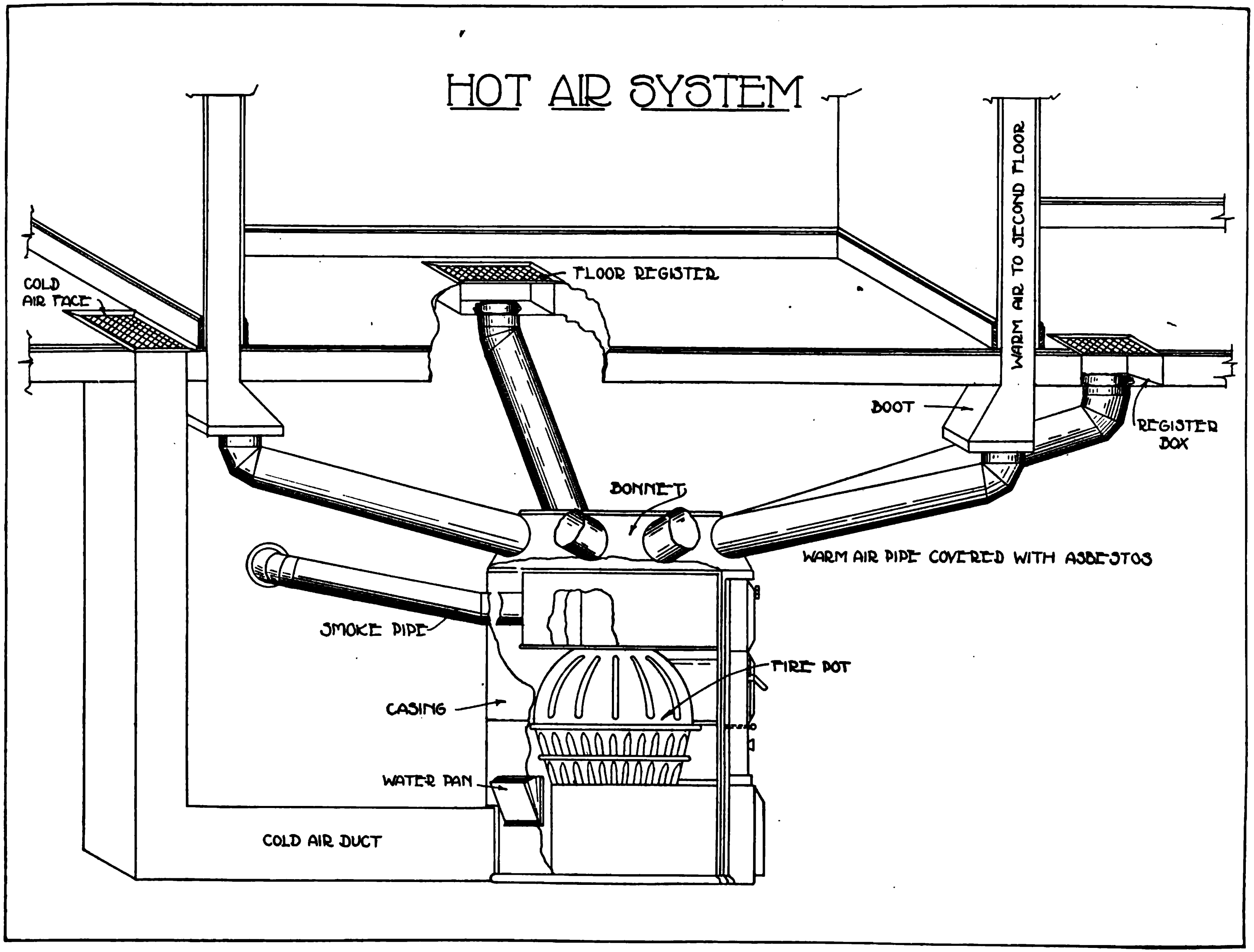

HOT AIR SYSTEM
FLOOR REGISTER
COLD AIR FACE
WARM AIR TO SECOND FLOOR
BOOT
REGISTER BOX
BONNET
WARM AIR PIPE COVERED WITH ASBESTOS
SMOKE PIPE
FIRE POT
CASING
WATER PAN
COLD AIR DUCT

PLATE XXX.

over the fire in the boiler, so that if the water line goes low this plug will melt and the steam will blow off into the fire and put it out.

The steam heating system is especially adapted for large installations, owing to the ease with which far off radiators may be quickly reached. Another advantage lies in its highly sensitive operation, giving almost immediate results from firing. For instance, in a large building, such as a school, where it is desired to get up heat quickly to combat a sudden drop in outside temperature, a steam plant will be found much more responsive to firing than a hot water plant would, as it takes much longer to heat up a large volume of water, than it does the small amount contained in a steam boiler. When the plant gets down to small proportions, as it does in a residence, this sensitive feature of the system becomes a disadvantage, rather than an advantage, as it means that the plant will have to have more attention to keep a steady temperature. This is, however, overcome to a considerable extent by the use of an automatic diaphragm regulator, which controls the draft doors of the boiler, according to the pressure of steam in the boiler.

To determine the size of the boiler and radiators required is a problem often given to the architect for solution. They depend entirely upon the square feet of radiation. Radiation depends upon three factors: the size and location of the rooms, the square feet of their glass exposure, and the square feet of outside or exposed wall surface.

To determine the radiation, under the "Mills Rule"—the 2-20-200, as it is sometimes called—proceed as follows:

Find the cubic feet of each room—length, times width, times height. Divide this product by 200.

Find the square feet of exposed or outside wall, not deducting the space occupied by doors or windows. Divide this number by 20.

Find the square feet of glass, counting outside doors as glass. Divide this number by 2.

The total of these three results will give the number of square feet of radiation required for the room. The sum of all the rooms to be heated will give the radiation required for the house.

As an example, consider a room 12′ x 15′ with a 9′ ceiling. It contains two windows each 3′ x 6′ in size, opening on one outside wall.

12′ x 15′ x 9′ = 1,620 cubic feet.
3′ x 6′ x 2′ = 36 square feet.
15′ x 9′ = 135 square feet.
1,620 ÷ 200 = 8.1
36 ÷ 2 = 18.0
135 ÷ 20 = 6.75
32.85 square feet of radiation required.

When determined for the entire house, the following table will give the size of boiler required:

CAPACITIES OF STEAM BOILERS

Capacity in Sq. Ft. of Steam Radiation	Diameter of Grate	Size Tappings	Height of Outlet
275	16″	3″	51″
325	18″	2-2½″	50¾″
375	18″	2-2½″	55¾″
400	18″	2-2½″	60¾″
500	21″	2-3″	55½″
550	21″	2-3″	60¼″
650	24″	2-3″	55½″
700	24″	2-3″	60¼″
875	28″	2-3½″	55½″
1125	31″	2-4″	58½″
1200	31″	2-4″	63¼″
1275	31″	2-4″	68″

Two column radiators are usually used, excepting where the radiator is placed below a window sill, in which case one wider and shorter will be needed.

Hot Water System of Heating. The working principles of the ordinary hot water system are very simple, as can be noted upon Plate XXXII. Opening the feed cock and the air valves fills the system with water—all air being driven out at the radiators. These valves are closed as soon as the water comes from them. The pressure rises above 10 pounds and flows into the expansion tank in the attic through the heat intensifier. When the water in the tank shows about one inch in the gauge, the feed cock is closed. The fire is now started under the boiler, and the water in it becomes heated. As it rises in temperature, it becomes lighter, forcing itself up into the main and on into the radiators. In them it cools, giving off its heat in the room, and, as cool water, returns to the boiler through the return pipe. Here it is heated again, and starts out on the same journey, keeping this circulation up as long as there is any fire in the fire box.

The object of the heat intensifier is to keep a pressure on the water in the system—usually ten pounds. Water in a tea kettle will boil at 212 degrees F. If the kettle could be sealed so that there is a pressure of ten pounds on the water, it would not boil until it reached a temperature of 240 degrees F. This attachment, then, causes the temperature of the water in the system to become heated to a higher degree than it would under no pressure, and this heat, being driven off in the rooms, adds to the efficiency of the system. If the pressure becomes

TABLES OF RADIATOR SIZES

TWO COLUMN

No. of Sections	Length 2½ in. per Sec.	Heating Surface—Square Feet					
		45 in. Height 6 sq. ft. per Sec.	38 in. Height 5 sq. ft. per Sec.	32 in. Height 4⅓ sq. ft. per Sec.	26 in. Height 2⅔ sq. ft. per Sec.	23 in. Height 2⅓ sq. ft. per Sec.	20 in. Height 2 sq. ft. per Sec.
2	5	10	8	6⅔	5⅓	4⅔	4
3	7½	15	12	10	8	7	6
4	10	20	16	13⅓	10⅔	9⅓	8
5	12½	25	20	16⅔	13⅓	11⅔	10
6	15	30	24	20	16	14	12
7	17½	35	28	23⅓	18⅔	16⅓	14
8	20	40	32	26⅔	21⅓	18⅔	16
9	22½	45	36	30	24	21	18
10	25	50	40	33⅓	26⅔	23⅓	20
11	27½	55	44	36⅔	29⅓	25⅔	22
12	30	60	48	40	32	28	24
13	32½	65	52	43⅓	34⅔	30⅓	26
14	35	70	56	46⅔	37⅓	32⅔	28
15	37½	75	60	50	40	35	30
16	40	80	64	53⅓	42⅔	37½	32
17	42½	85	68	56⅔	45⅓	39⅔	34
18	45	90	72	60	48	42	36
19	47½	95	76	63⅓	50⅔	44⅓	38
20	50	100	80	66⅔	53⅓	46⅔	40

THREE COLUMN

No. of Sections	Length 2½ in. per Sec.	Heating Surface—Square Feet					
		44 in. Height 6 sq. ft. per Sec.	38 in. Height 5 sq. ft. per Sec.	32 in. Height 4½ sq. ft. per Sec.	26 in. Height 3¾ sq. ft. per Sec.	23 in. Height 3¼ sq. ft. per Sec.	20 in. Height 2¾ sq. ft. per Sec.
2	5	12	10	9	7½	6½	5½
3	7½	18	15	13½	11¼	9¾	8¼
4	10	24	20	18	15	13	11
5	12½	30	25	22½	18¾	16¼	13¾
6	15	36	30	27	22½	19½	16½
7	17½	42	35	31½	26¼	22¾	19¼
8	20	48	40	36	30	26	22
9	22½	54	45	40½	33¾	29¼	24¾
10	25	60	50	45	37½	32½	27½
11	27½	66	55	49½	41¼	35¾	30¼
12	30	72	60	54	45	39	33
13	32½	78	65	58½	48¾	42¼	35¾
14	35	84	[illegible]	[illegible]	52½	45½	38½
15	37½	90	[illegible]	[illegible]	56¼	[illegible]	[illegible]
16	40	96	[illegible]	[illegible]	60	[illegible]	[illegible]
17	42½	102	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	45	108	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	47½	114	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	50	120	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

These radiator sizes also apply wher[illegible] is

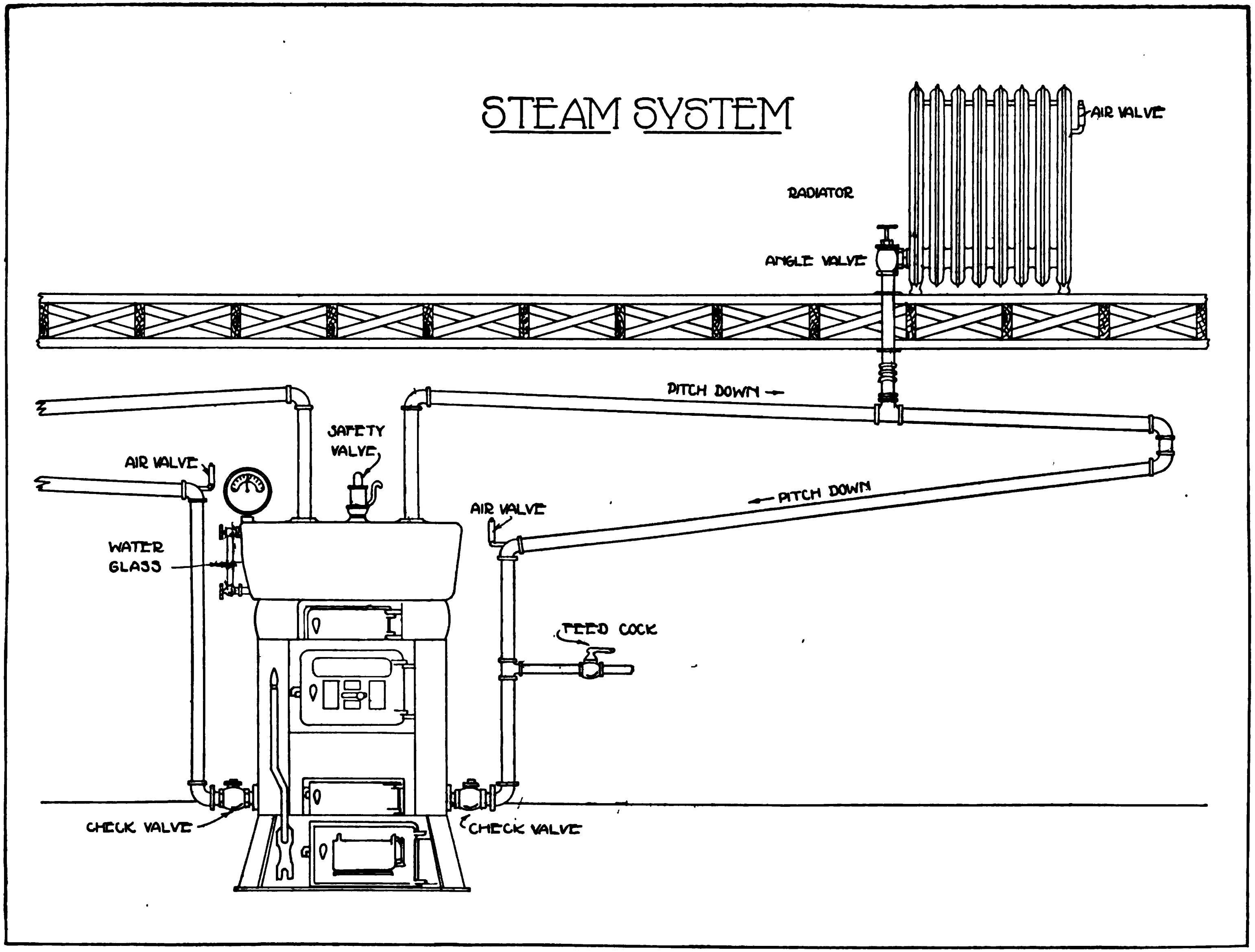

STEAM SYSTEM
AIR VALVE
RADIATOR
ANGLE VALVE
PITCH DOWN
SAFETY VALVE
AIR VALVE
WATER GLASS
PITCH DOWN
AIR VALVE
FEED COCK
CHECK VALVE
CHECK VALVE

PLATE XXXI.

Two column radiators are usually used, excepting where the radiator is placed below a window sill, in which case one wider and shorter will be needed.

Hot Water System of Heating. The working principles of the ordinary hot water system are very simple, as can be noted upon Plate XXXII. Opening the feed cock and the air valves fills the system with water—all air being driven out at the radiators. These valves are closed as soon as the water comes from them. The pressure rises above 10 pounds and flows into the expansion tank in the attic through the heat intensifier. When the water in the tank shows about one inch in the gauge, the feed cock is closed. The fire is now started under the boiler, and the water in it becomes heated. As it rises in temperature, it becomes lighter, forcing itself up into the main and on into the radiators. In them it cools, giving off its heat in the room, and, as cool water, returns to the boiler through the return pipe. Here it is heated again, and starts out on the same journey, keeping this circulation up as long as there is any fire in the fire box.

The object of the heat intensifier is to keep a pressure on the water in the system—usually ten pounds. Water in a tea kettle will boil at 212 degrees F. If the kettle could be sealed so that there is a pressure of ten pounds on the water, it would not boil until it reached a temperature of 240 degrees F. This attachment, then, causes the temperature of the water in the system to become heated to a higher degree than it would under no pressure, and this heat, being driven off in the rooms, adds to the efficiency of the system. If the pressure becomes

TABLES OF RADIATOR SIZES

TWO COLUMN

No. of Sections	Length 2½ in. per Sec.	Heating Surface—Square Feet					
		45 in. Height 6 sq. ft. per Sec.	38 in. Height 5 sq. ft. per Sec.	32 in. Height 4½ sq. ft. per Sec.	26 in. Height 2⅔ sq. ft. per Sec.	23 in. Height 2⅓ sq. ft. per Sec.	20 in. Height 2 sq. ft. per Sec.
2	5	10	8	6⅔	5⅓	4⅔	4
3	7½	15	12	10	8	7	6
4	10	20	16	13⅓	10⅔	9⅓	8
5	12½	25	20	16⅔	13⅓	11⅔	10
6	15	30	24	20	16	14	12
7	17½	35	28	23⅓	18⅔	16⅓	14
8	20	40	32	26⅔	21⅓	18⅔	16
9	22½	45	36	30	24	21	18
10	25	50	40	33⅓	26⅔	23⅓	20
11	27½	55	44	36⅔	29⅓	25⅔	22
12	30	60	48	40	32	28	24
13	32½	65	52	43⅓	34⅔	30⅓	26
14	35	70	56	46⅔	37⅓	32⅔	28
15	37½	75	60	50	40	35	30
16	40	80	64	53⅓	42⅔	37½	32
17	42½	85	68	56⅔	45⅓	39⅔	34
18	45	90	72	60	48	42	36
19	47½	95	76	63⅓	50⅔	44⅓	38
20	50	100	80	66⅔	53⅓	46⅔	40

THREE COLUMN

No. of Sections	Length 2½ in. per Sec.	Heating Surface—Square Feet					
		44 in. Height 6 sq. ft. per Sec.	38 in. Height 5 sq. ft. per Sec.	32 in. Height 4½ sq. ft. per Sec.	26 in. Height 3¾ sq. ft. per Sec.	23 in. Height 3¼ sq. ft. per Sec.	20 in. Height 2¾ sq. ft. per Sec.
2	5	12	10	9	7½	6½	5½
3	7½	18	15	13½	11¼	9¾	8¼
4	10	24	20	18	15	13	11
5	12½	30	25	22½	18¾	16¼	13¾
6	15	36	30	27	22½	19½	16½
7	17½	42	35	31½	26¼	22¾	19¼
8	20	48	40	36	30	26	22
9	22½	54	45	40½	33¾	29¼	24¾
10	25	60	50	45	37½	32½	27½
11	27½	66	55	49½	41¼	35¾	30¼
12	30	72	60	54	45	39	33
13	32½	78	65	58½	48¾	42¼	35¾
14	35	84	70	63	52½	45½	38½
15	37½	90	75	67½	56¼	48¾	41¼
16	40	96	80	72	60	52	44
17	42½	102	85	76½	63¾	55¼	46¾
18	45	108	90	81	67½	58½	49½
19	47½	114	95	85½	71¼	61¾	52¼
20	50	120	100	90	75	65	55

These radiator sizes also apply where hot water is used.

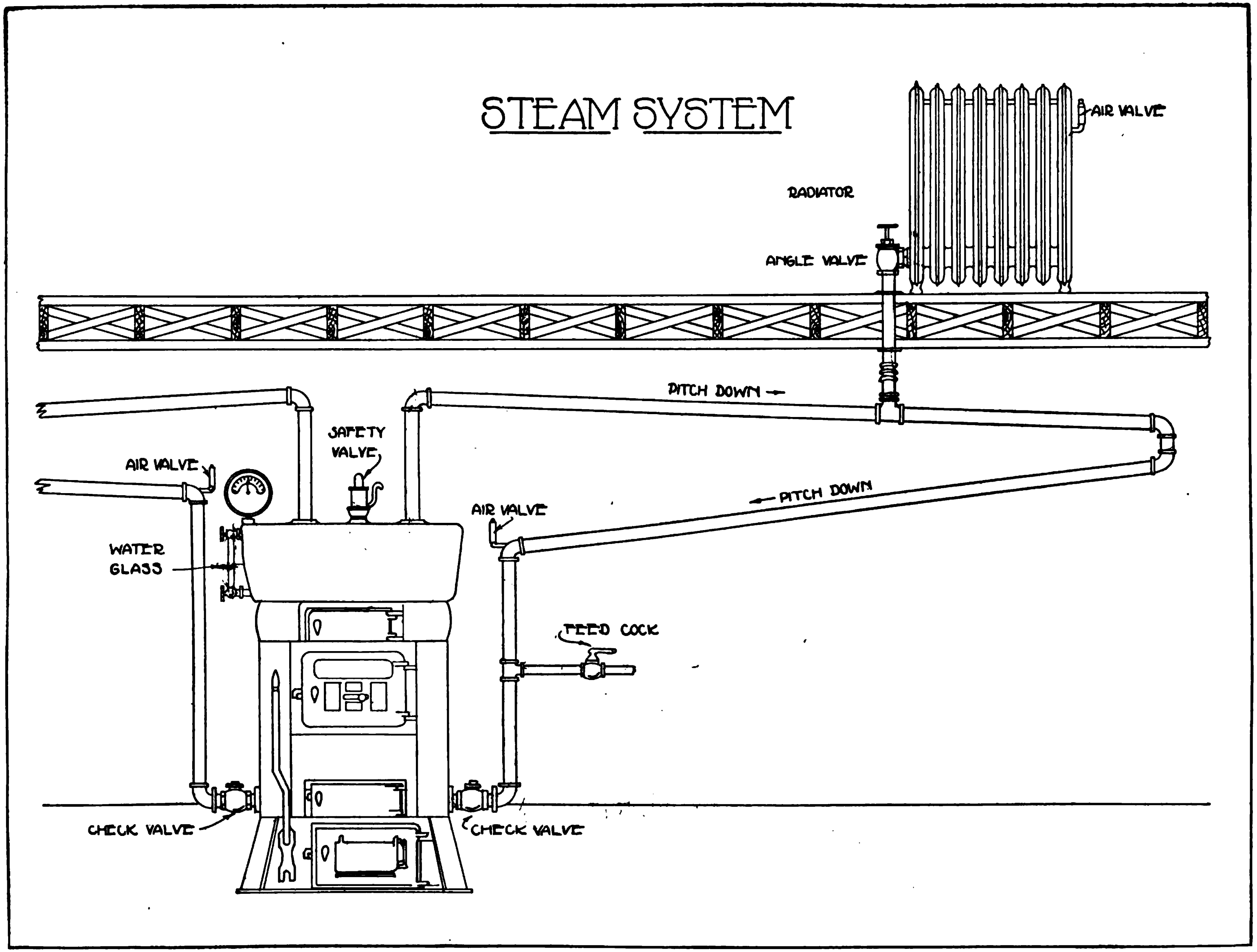

STEAM SYSTEM
AIR VALVE
RADIATOR
ANGLE VALVE
PITCH DOWN
SAFETY VALVE
AIR VALVE
PITCH DOWN
AIR VALVE
WATER GLASS
FEED COCK
CHECK VALVE
CHECK VALVE

PLATE XXXI.

FOUR COLUMN

No. of Sections	Length 3 in. per Sec.	Heating Surface—Square Feet					
		45 in. Height 10 sq. ft per Sec.	38 in. Height 8 sq. ft. per Sec.	32 in. Height 6½ sq. ft. per Sec.	26 in. Height 5 sq. ft. per Sec.	22 in. Height 4 sq. ft. per Sec.	18 in. Height 3 sq. ft. per Sec.
2	6	20	16	13	10	8	6
3	9	30	24	19½	15	12	9
4	12	40	32	26	20	16	12
5	15	50	40	32½	25	20	15
6	18	60	48	39	30	24	18
7	21	70	56	45½	35	28	21
8	24	80	64	52	40	32	24
9	27	90	72	58½	45	36	27
10	30	100	80	65	50	40	30
11	33	110	88	71½	55	44	33
12	36	120	96	78	60	48	36
13	39	130	104	84½	65	52	39
14	42	140	112	91	70	56	42
15	45	150	120	97½	75	60	45
16	48	160	128	104	80	64	48
17	51	170	136	110½	85	68	51
18	54	180	144	117	90	72	54
19	57	190	152	123½	95	76	57
20	60	200	160	130	100	80	60

greater than ten pounds, the water is allowed to flow up into the expansion tank. When the fire dies down and the water is cooled, a valve permits it to flow back, thus keeping the system automatically filled. In some hot water systems, a bowl of mercury is used instead of the patent device of intensifying here described.

The hot water system of heating is the most economical from a fuel-burning standpoint, most reliable, simplest to take care of, and is not subject to sudden temperature changes, being slower to heat up and slower to cool off than the other systems. For a small home, it is the ideal system of heating, although its first cost sometimes prohibits its installation. It has another disadvantage, though, that is worthy of consideration. In the spring and fall, when it is cool in the mornings and a quick, short fire is needed, this system takes so long

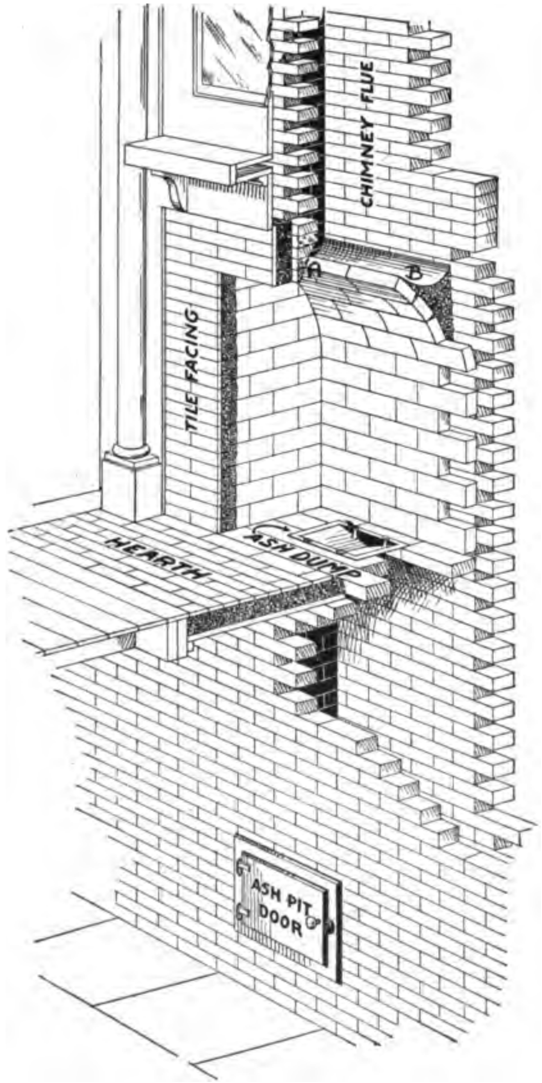


FIGURE 61

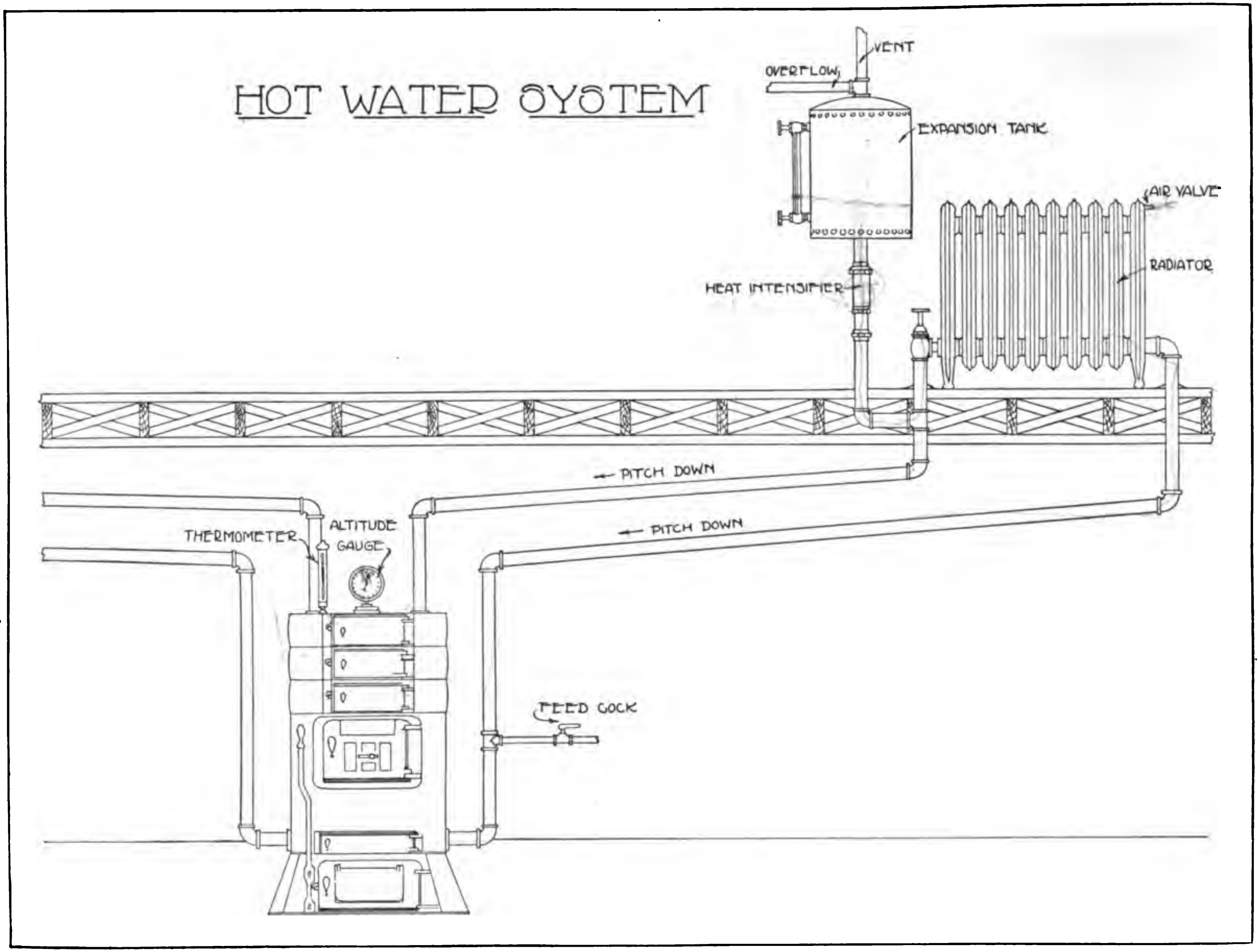

HOT WATER SYSTEM
VENT
OVERFLOW
EXPANSION TANK
AIR VALVE
RADIATOR
HEAT INTENSIFIER
PITCH DOWN
PITCH DOWN
THERMOMETER
ALTITUDE GAUGE
FEED COCK

PLATE XXXII.

to heat up, and retains its heat for such a great length of time, that it fails to meet the conditions. But this point though it may be a disadvantage in the spring, is a great point in its favor during the winter months.

To estimate the amount of hot water radiation required to heat a building, proceed as has been described for steam heating, and to the result attained, add 60%. For instance, if you had 100 sq. ft. of radiation for steam, you would have 160 sq. ft. for hot water.

Radiator sizes can be determined from the foregoing tables, and heater sizes from the following:

CAPACITIES OF HOT WATER HEATERS

Capacity in Sq. Ft. of Hot Water Radiation	Diameter of Grate	Size of Tappings	Height of Outlet
450	16"	3"	45"
525	18"	2-2½"	44"
600	18"	2-2½"	49"
825	21"	2-3"	49"
1100	24"	2-3"	49½"
1550	28"	2-3½"	54½"
2100	31"	2-4"	62½"

Fireplace. Although the fireplace is nowadays regarded more as a decoration, this chapter would not be complete without some mention of it. Figure 61 illustrates typical fireplace construction, and a study of it will make this construction very clear.

The floor joists are framed around with headers, and the opening arched. Above the arch the space is filled in with concrete, topped level with the floor with tile or brick.

The area of the throat, *A*, should be made exactly one tenth that of the fireplace opening, or it will smoke. The ledge, *B*, closes this opening. As the size of the throat diminishes, it comes flush with the flue at a point exactly over the center of the fireplace. The ledge is curved upward to divert down drafts which would otherwise blow smoke into the room.

A poorly constructed fireplace is most unpleasant, and only men with experience should ever be engaged to build one.

REFERENCES

R. M. Starbuck—"Standard Practical Plumbing."
Chas. L. Hubbard—"Heating and Ventilation."
W. B. Gray—"Plumbing."

CHAPTER XVI

BUILDING A HOME OF ONE'S OWN

It is not to be wondered at that sometime in a man's career, he possesses an ardent desire to build a home of his own. A feeling of community importance, selfsatisfaction, and family interest, only come to the man who is living in his *own home*—not the *house* of another. If he plans his own home, and closely follows it to completion, to the other interests is added an element of *pride*.

So, with these thoughts in mind, this chapter has been appended to help the student—when he is a little older—to build a home of his own.

Buying the Lot. There are two elements that enter into the purchasing of the building site—the available funds and the owner's personal desires. Concerning the former, it is always better to put as much—or even a little more—into the lot, as one can possibly afford. From the standpoint of an investment alone, this is desirable. The lot, probably, will never decrease in value, as the house will in time. If in later years it is desired to sell the property, it will be the lot—not the house—that increases its value. It will be the lot that pays interest on the investment.

One should buy all the land one can for the available money. A large lot, on the outskirts, is more desirable than a cramped lot "close in." If purchased in some promoted "addition," two lots should be bought on one of which the home should be built. Figure 62 illustrates a little bungalow built in such an "addition"—close to its neighbor on one side, but with plenty of room on the other. This vacant lot can be used as a garden spot—a place of beauty for the children to romp around on—and, if times prove hard—it can always be sold at a good profit.

One should know the man of whom one buys. If it is the owner, and he is very desirous to sell, the purchaser should let him know that he is considering other property. The seller will be less likely to boost the price. The value of the land in the neighborhood should be ascertained and its future value be taken into account.

If it is a real estate agent, one should be assured as to his responsibility. If he has a good reputation—and that will be his only business asset—he will undoubtedly give full value for one's money, as it is his business to know land values.

Care must be taken to see that there are no claims against the property. If the sewer, curbing, pavements, etc., are in—that is, if the land is improved—these improvements must be regarded, as, some day, if they are not already made, their expense will be assessed against the lot. Trees and shrubbery add to the value of the lot. If the land is bare, a house will look "lonesome" until saplings have grown. See Figure 63. Too many trees may make a house *damp*, but just enough make it *pleasant*. Figure 64 is an illustration of this point. The little trees already produce an attractiveness, which, as they grow, will increase.

There are still other points to consider. The neighborhood—would the neighbors be congenial? The nearness of schools, stores, churches, car lines, fire stations, etc. Is the land graded, or will there be the expense of filling in or cutting down, as the case may be?

These are problems to consider when purchasing a lot. Good, sound, common sense is the only solution for them.

The Planning of the Home. If one does not have the practical building experience necessary to construct a home, the services of a good architect should be secured. His ex-

FIGURE 62.

FIGURE 63.

FIGURE 64.

perience with men and materials will more than offset the extra expense.

Before turning the job over to him, the home should be planned. Let the copartner do her share. She will have her own ideas concerning conveniences. They should be considered—toned down if necessary—but put into practical form. It is her job to run the house, and she should have some voice in the matter of its planning.

A number of sketches should be made—both plans and perspectives. Other homes should be studied in a search for ideas. Use should be made of building magazines and plan books—all replete with good suggestions.

When the builder is ready—all primed with information —he should go to a good architect. If one can make one's own working drawings, the fee may be cut down; but the architect should be engaged to do the superintending, and his advice should be followed on account of his superior technical knowledge.

Letting the Contract. When plans and specifications are ready, the architect will notify the contractors and call for bids on the job. There are two methods of letting a job—the general contract, and the separate contracts. Although the former is a little higher, usually—as the general contractor must add a profit to the work of each—it places the responsibility on the shoulders of one man. When the masonry is finished, he will put the carpenters to work; when they are far enough along, the plumbers, heating men, and painters; whereas the owner or the architect will have to attend to these details if a separate contract is let for each division of the work. A house let on a general contract is usually a better house and a more rapidly built one than one built under separate contracts.

It will take from two weeks to a month to receive all bids, which are opened at one time and the work let to the lowest, usually. If the lowest is too high—the architect will know —all bids can be rejected and new ones called for.

Sometimes the lowest bid is too low, and in that case—unless the architect knows the bidder to be reliable—the job may go out at a higher figure. A contractor that feels himself losing money on a job, will slight it—no matter how closely he may be watched. And no owner desires to feel that the contractor is losing money—not only is this a matter of ethics —but he wants a good job and good materials in his *own* home.

When the contractor has been decided upon, the contract is signed. This is usually in the form adopted by the American Institute of Architects.* The contractor puts up a bond—if desired by the owner—and the work is begun.

Building the Home. From now on the owner should stay in the background. Contractors are "touchy" mortals, and they do resent any interference. If the owner is not satisfied, he can appeal to the architect, who has full power to force the contractor to terms—as it is more to the owner's advantage if he does not antagonize the contractor.

The building should be followed to completion. The builder should see that no "extras" are forced upon him and should not agree to them unless the architect so advises.

When the building is completed, all cleaned and truck carried away, the contractor should be paid in full, if his work is perfectly satisfactory. His bond protects against failures, as his sureties can be forced to complete any work that he has not finished as it should be.

There is much satisfaction in becoming a member of the greatest organization in the world—an "American Home-Owner."

REFERENCES

Chas. A. White—"Successful Houses and How To Build Them."

*A copy can be secured by the teacher from any architect that is a member.

CHAPTER XVII

DATA AND MISCELLANEOUS TABLES

There is a great deal of data to which students must have access when planning a building. The following tables will be of help:

TABLE I

Average Sizes of Furniture (No Heights Given)

Center Tables	34" x 34"	28" x 28"	24" x 24"
Library Tables	30" x 48"	28" x 42"	24" x 36"
Morris Chairs	26" x 26"	24" x 24"	24" x 26"
Rockers	39" x 39"	26" x 26"	29" x 29"
Rugs	9' x 12'	7'6" x 9'	11'3" x 12'
Small Rugs	22" x 36"	27" x 54"	36" x 72"
Ladies' Desks	22" x 30"	20" x 27"	19" x 38"
Davenports	34" x 80"	30" x 80"	29" x 78"
Side Chairs	18" x 18"	17" x 17"	16" x 17"
Couches	30" x 78"	29" x 77"	31" x 82"
Book Cases	16" x 41"	16" x 60"	17" x 40"
Upright Pianos	40" x 76"	48" x 78"	38" x 78"
Phonographs	18" x 18"	14" x 18"	24" x 24"
Dining Tables	42" x 42"	48" x 48"	54" x 54"
Sideboards	24" x 55"	26" x 44"	26" x 61"
China Closets	24" x 47"	24" x 45"	25" x 42"
Dining Chairs	18" x 18"	16" x 17"	15" x 17"
Ranges	26" x 34"	28" x 37"	30" x 36"
Kitchen Cabinets	25" x 42"	26" x 46"	27" x 40"
Refrigerators	17" x 26"	25" x 39"	19" x 33"
Beds, Single	36" x 78"	....	......
Beds, Three-quarter	48" x 78"	....	......
Beds, Double	54" x 80"	....	......
Dressing Tables	19" x 31"	22" x 44"	24" x 45"
Chiffoniers	20" x 35"	19" x 31"	20" x 32"

TABLE II

Conventional Heights of Electric Wall Outlets

Living Rooms	5' 6"
Chambers	5'
Offices	6'
Corridors	6' 3"
Height of Switches	4'

TABLE III

Plumbing Fixtures (Outside Dimensions)

Fixture	Width	Length
Bath Tubs	30"	54" 66" 72"
Wall Lavatories	18" 22"	24" 21" 27"
Corner Lavatories	16" 18"	16" 24"
Kitchen Sinks	18" 20"	30" 30" 36"
Drain Boards	18" 20"	24" 24"
Closets	18"	24" (from wall)
Laundry Tubs (Single)	24"	25" 27" 31"
Laundry Tubs (Double)	24"	48" 54" 60"
Laundry Tubs (Triple)	24"	72" 80" 90"

Cellar Floor Drains........6"x 6", 8" x 8", 10" x 10"
Cast Iron Soil Pipe........2" outside, 3½" over hub
Cast Iron Soil Pipe........4" outside, 6" over hub

TABLE IV

Safe Bearing Value of Foundation Soils

Material	Tons per Square Foot
Granite formation	30
Limestone, compact beds	25
Sandstone, compact beds	20
Soft friable rock	8 to 10
Gravel and sand, compact	6 to 10
Gravel, dried and coarse compact	6
Clay, dried in thick beds	4
Clay, moderately dry, thick beds	3
Clay, soft	1½
Sand, compact, confined	4
Sand, clean and dry, confined	2
Earth, solid and dry	4

TABLE V

Average Life of Building Materials

The figures given below are averages deduced from replies made by eighty-three competent builders in twenty-seven cities and towns of western states.

Under average conditions and in temperate climates they may be regarded as correct. In very damp or very dry locations, an allowance must be made.

Life and Depreciation of Building Materials

Material in Buildings	Frame Dwellings: Average Life, Years	Frame Dwellings: Percentage of Depreciation per Annum	Brick Dwellings Shingle Roof: Average Life, Years	Brick Dwellings Shingle Roof: Percentage of Depreciation per Annum	Frame Stores: Average Life, Years	Frame Stores: Percentage of Depreciation per Annum	Brick Stores (Shingle Roof): Average Life, Years	Brick Stores (Shingle Roof): Percentage of Depreciation per Annum
Brick	......	......	75	1⅛	......	......	66	1½
Plastering	20	5	30	3⅓	16	6	30	3⅓
Painting, outside	5	20	7	14	5	20	6	16
Painting, inside	7	14	7	14	5	20	6	16
Shingles	16	6	16	6	16	6	16	6
Cornice	40	2½	40	2½	30	3⅓	40	2½
Weather-boarding	30	3⅓	......	......	30	3⅓	......	......
Sheathing	50	2	50	2	40	2½	50	2
Flooring	20	5	20	5	13	8	13	8
Doors, complete	30	3⅓	30	3⅓	25	4	30	3⅓
Windows, complete	30	3⅓	30	3⅓	25	4	30	3⅓
Stairs and newel	30	3⅓	30	3⅓	20	5	20	5
Base	40	2½	40	2½	30	3⅓	30	3⅓
Inside blinds	30	3⅓	30	3⅓	30	3⅓	30	3⅓
Building hardware	20	5	20	5	13	8	13	8
Piazzas and Porches	20	5	20	5	20	5	20	5
Outside blinds	16	6	16	6	16	6	16	6
Sills and 1st floor joists	25	4	40	2½	25	4	30	3⅓
Dimension lumber	50	2	75	1⅓	40	2½	66	1½

TABLE VI

Average Weight of Timber

	Pounds per Cubic Foot
Ash	42
Chestnut	41
Hemlock	25
Hickory	53
Maple	49
Oak	32 to 48
Pine, Norway	36
Pine, white	25
Pine, yellow, Northern	34
Pine, yellow, Southern	45
Spruce	25

To find the weight of a board foot of these materials, divide the weight given by 12.

TABLE VII

Sizes of Brick, Hollow Tile, and Cement Blocks

BRICK

Common Brick—Standard	2¼″ x 4″ x 8¼″
Pressed Brick—Standard	2¼″ x 4⅛″ x 8⅜″
Pressed Brick—Roman	1 11-16″ x 4″ x 11¾″
Impervious Brick—Standard	2¼″ x 4″ x 8⅛″
Impervious Brick—Roman	1⅝″ x 4″ x 11½″

HOLLOW TILE (NATCO)

2″ x 8″ x 12″	4″ x 10″ x 12″	10″ x 12″ x 12″
3″ x 12″ x 12″	6″ x 12″ x 12″	12″ x 12″ x 12″
4″ x 12″ x 12″	8″ x 12″ x 12″	Slabs 1″ x 8″ x 10″
		Slabs 1″ x 8″ x 12″

CEMENT BLOCKS

8″ x 8″ x 16″	4″ x 12″ x 16″	4″ x 8″ x 24″
8″ x 10″ x 16″	8″ x 4″ x 16″	4″ x 10″ x 24″
8″ x 12″ x 16″	8″ x 8″ x 24″	4″ x 12″ x 24″
4″ x 8″ x 16″	8″ x 10″ x 24″	8″ x 4″ x 24″
4″ x 10″ x 16″	8″ x 12″ x 24″	

TABLE VIII

Sizes of Spouts and Gutters

2″ down spout will drain 3½″ gutter 12 feet long.
3″ down spout will drain 3½″ gutter 12 to 25 feet long.
3″ down spout will drain 4″ gutter 25 to 35 feet long.
4″ down spout will drain 5″ gutter 35 to 45 feet long.
5″ down spout will drain 6″ gutter 45 to 55 feet long.
6″ down spout will drain 7″ gutter 55 to 65 feet long.
7″ down spout will drain 8″ gutter 65 to 75 feet long.

TABLE IX

Angle Between Rafter and Horizontal for Various Roof Pitches

Pitch of Roof	Angle Corresponding	Pitch of Roof	Angle Corresponding	Pitch of Roof	Angle Corresponding
1-24	4° 46′	3- 8	36° 53′	17-24	54° 47′
1-12	9° 28′	5-12	39° 48′	3- 4	56° 19′
1- 8	14° 2′	11-24	42° 31′	19-24	57° 44′
1- 6	18° 26′	1- 2	45° 0′	5- 6	59° 2′
5-24	22° 37′	13-24	47° 18′	7- 8	60° 17′
1- 4	26° 34′	7-12	49° 24′	11-12	61° 23′
7-24	30° 15′	5- 8	51° 21′	23-24	62° 27′
1- 3	33° 41′	2- 3	53° 8′	1	63° 26′

TABLE X

Actual Sizes of Lumber

About 95 per cent of the southern yellow pine on the market is classified and graded according to the rules of the Southern Yellow Pine Manufacturers' Association and runs from ¼ to ⅝ inch smaller in dimension than called for by its nominal size. Table VII gives the actual sizes of the various nominal sizes of yellow pine lumber as given by the above named association. Where the letters S-1-S-1-E are used it means that the lumber is surfaced or planed on one side and one edge only, while S-4-S designates that the material is surfaced on all four sides.

Table Showing Actual Sizes of Lumber Dimensions, in Inches

(Southern Yellow Pine Manufacturers' Association)

FOR S. 1 S. 1 E.

Breadth	2 in.	4 in.	6 in.	8 in.	10 in.	12 in.
Depth						
4 in.	1⅝x 3⅝	3⅝x 3⅝				
6 in.	1⅝x 5⅝	3⅝x 5⅝	5⅝x 5⅝			
8 in	1⅝x 7½	3⅝x 7⅝	5¾x 7¾	7¾x 7¾		
10 in.	1⅝x 9½	3⅝x 9⅝	5¾x 9¾	7¾x 9¾	9¾x 9¾	
12 in.	1⅝x11½	3⅝x11⅝	5¾x11¾	7¾x11¾	9¾x11¾	11¾x11¾

FOR S. 4 S.

4 in.	1½x 3½	3½x 3½				
6 in.	1½x 5½	3½x 5½	5½x 5½			
8 in.	1½x 7⅜	3½x 7½	5½x 7½	7½x 7½		
10 in.	1½x 9⅜	3½x 9½	5½x 9½	7½x 9½	9½x 9½	
12 in.	1½x11⅜	3½x11½	5½x11½	7½x11½	9½x11½	11½x11½

TABLE XI

Average Safe Working Stresses in Bending for Timber

White Oak	1,200	pounds per sq. inch
Southern Long Leaf or Georgia Yellow Pine	1,200	" " " "
Short Leaf Yellow Pine	1,000	" " " "
Norway Pine	800	" " " "
Cypress	800	" " " "
California Spruce	800	" " " "
Chestnut	800	" " " "
Douglas Fir	800	" " " "
California Redwood	750	" " " "
White Pine	700	" " " "
Spruce	700	" " " "
Eastern Fir	700	" " " "
Cedar	700	" " " "
Hemlock	600	" " " "

TABLE XII

Volume of Compacted Cement, Sand, Mortar and Stone or Gravel Concrete per Sack of Cement, Also Materials Required

Mixtures			Materials			Vol. in Cubic Feet	
Cement	Sand	Gravel or Stone	Cement in Sacks	Sand in Cu. Ft.	Gravel or Stone Cu. Ft.	Mortar	Concrete
1	1½		1	1.5		1.75	
1	2		1	2.0		2.1	
1	2½		1	2.5		2.48	
1	3		1	3.0		2.82	
1	1½	3	1	1.5	3.0		3.52
1	2	3	1	2.0	3.0		3.9
1	2	4	1	2.0	4.0		4.48
1	2½	4	1	2.5	4.0		4.85
1	2½	5	1	2.5	5.0		5.45
1	3	5	1	3.0	5.0		5.80
1	3	6	1	3.0	6.0		6.40

TABLE XIII
Materials Required for One Cubic Yard of Compacted Cement, Sand, Mortar and Stone or Gravel Concrete

Mixtures			Quantities of Materials				
Cement	Sand	Stone or Gravel	Cement in Sacks	Sand Cu. Ft.	Sand Cu. Yds.	Stone or Gravel Cu. Ft.	Stone or Gravel Cu. Yds.
1	1½		15.48	23.2	.86		
1	2		12.84	25.6	.95		
1	2½		10.96	27.3	1.01		
1	3		9.56	28.6	1.06		
1	1½	3	7.64	11.3	.42	23.0	.85
1	2	3	6.96	14.0	.52	20.8	.77
1	2	4	6.04	12.2	.45	24.0	.89
1	2½	4	5.56	13.8	.51	22.1	.82
1	2½	5	4.96	12.4	.46	24.8	.92
1	3	5	4.64	14.0	.52	23.2	.86
1	3	6	4.24	12.7	.47	25.4	.94

Stone and gravel considered as having 45% voids.
Tables based on 1 sack cement = 1 cubic foot.
4 sacks cement = 1 barrel.
NOTE—These quantities may vary 10% in either direction, depending upon the materials used and the compactness of the concrete.
Based on tables in "Concrete—Plain and Reinforced," by Taylor and Thompson.

TABLE XIV
Weight of Various Building Materials

1 cubic foot of sand, solid, weighs 112½ lbs.
1 cubic foot of sand, loose, weighs 95 lbs.
1 cubic foot of earth, loose, weighs 93¾ lbs.
1 cubic foot of common soil weighs 124 lbs.
1 cubic foot of strong soil weighs 127 lbs.
1 cubic foot of clay weighs 120 to 135 lbs.
1 cubic foot of clay and stone weighs 160 lbs.
1 cubic foot of common stone weighs 160 lbs.
1 cubic foot of brick weighs 95 to 120 lbs.
1 cubic foot of granite weighs 169 to 180 lbs.
1 cubic foot of marble weighs 166 to 170 lbs.
1 cubic yard of sand weighs 3,037 lbs.
1 cubic yard of common soil weighs 3,429 lbs.

TABLE XV
Queen Anne 2 Light Check Rail Windows

Size of Glass in Inches	Size of Frame Opening in Feet and Inches	Size of Glass in Inches	Size of Frame Opening in Feet and Inches
16 x 24	1 8 x 4 6	26 x 30	2 6 x 5 6
16 x 26	1 8 x 4 10	26 x 32	2 6 x 5 10
18 x 24	1 10 x 4 6	28 x 24	2 8 x 4 6
18 x 26	1 10 x 4 10	28 x 26	2 8 x 4 10
20 x 20	2 0 x 3 10	28 x 28	2 8 x 5 2
20 x 22	2 0 x 4 2	28 x 30	2 8 x 5 6
20 x 24	2 0 x 4 6	28 x 32	2 8 x 5 10
20 x 26	2 0 x 4 10	28 x 34	2 8 x 6 2
20 x 28	2 0 x 5 2	28 x 36	2 8 x 6 6
20 x 30	2 0 x 5 6	30 x 24	2 10 x 4 6
20 x 32	2 0 x 5 10	30 x 26	2 10 x 4 10
22 x 20	2 2 x 3 10	30 x 28	2 10 x 5 2
22 x 22	1 2 x 4 2	30 x 30	2 10 x 5 6
22 x 24	2 2 x 4 6	30 x 32	2 10 x 5 10
22 x 26	2 2 x 4 10	30 x 34	2 10 x 6 2
22 x 28	2 2 x 5 2	30 x 36	2 10 x 6 6
22 x 30	2 2 x 5 6	32 x 24	3 0 x 4 6
22 x 32	2 2 x 5 10	32 x 28	3 0 x 5 2
24 x 18	2 4 x 3 6	32 x 30	3 0 x 5 6
24 x 20	2 4 x 3 10	32 x 32	3 0 x 5 10
24 x 22	2 4 x 4 2	36 x 28	3 4 x 5 2
24 x 24	2 4 x 4 6	36 x 30	3 4 x 5 6
24 x 26	2 4 x 4 10	36 x 32	3 4 x 5 10
24 x 28	2 4 x 5 2	40 x 28	3 8 x 5 2
24 x 30	2 4 x 5 6	40 x 30	3 8 x 5 6
24 x 32	2 4 x 5 10	40 x 32	3 8 x 5 10
24 x 34	2 4 x 6 2	40 x 34	3 8 x 6 2
24 x 36	2 4 x 6 6	44 x 28	4 0 x 5 2
26 x 24	2 6 x 4 6	44 x 30	4 0 x 5 6
26 x 26	2 6 x 4 10	44 x 32	4 0 x 5 10
26 x 28	2 6 x 5 2	44 x 34	4 0 x 6 2

TABLE XVI
Stock Sizes of Wall Board Panels

3/16″ thick

32″ wide by 4, 5-4, 6, 7, 8, 9, 10 feet long
48″ wide by 4, 5-4, 6, 7, 8, 9, 10 feet long
64″ wide by 6, 7, 8, 9, 10 feet long

TABLE XVII
Thickness of Brick Walls

9, 13, 17, 22 inches

TABLE XVIII
Two Light Check Rail Windows
1⅜″ Thick

Size of Glass in Inches	Size of Frame Opening in Inches and in Feet	Size of Glass in Inches	Size of Frame Opening in Inches and in Feet
16 x 20	1 8 x 3 10	26 x 24	2 6 x 4 6
16 x 22	1 8 x 4 2	26 x 26	2 6 x 4 10
16 x 24	1 8 x 4 6	26 x 28	2 6 x 5 2
16 x 26	1 8 x 4 10	26 x 30	2 6 x 5 6
16 x 28	1 8 x 5 2	26 x 32	2 6 x 5 10
16 x 30	1 8 x 5 6	28 x 24	2 8 x 4 6
18 x 20	1 10 x 3 10	28 x 26	2 8 x 4 10
18 x 24	1 10 x 4 6	28 x 28	2 8 x 5 2
18 x 26	1 10 x 4 10	28 x 30	2 8 x 5 6
18 x 28	1 10 x 5 2	28 x 32	2 8 x 5 10
18 x 30	1 10 x 5 6	28 x 34	2 8 x 6 2
20 x 20	2 0 x 3 10	28 x 36	2 8 x 6 6
20 x 22	2 0 x 4 2	30 x 24	2 10 x 4 6
20 x 24	2 0 x 4 6	30 x 26	2 10 x 4 10
20 x 26	2 0 x 4 10	30 x 28	2 10 x 5 2
20 x 28	2 0 x 5 2	30 x 30	2 10 x 5 6
20 x 30	2 0 x 5 6	30 x 32	2 10 x 5 10
20 x 32	2 0 x 5 10	30 x 34	2 10 x 6 2
22 x 20	2 2 x 3 10	30 x 36	2 10 x 6 6
22 x 22	2 2 x 4 2	32 x 24	3 0 x 4 6
22 x 24	2 2 x 4 6	32 x 28	3 0 x 5 2
22 x 26	2 2 x 4 10	32 x 30	3 0 x 5 6
22 x 28	2 2 x 5 2	32 x 32	3 0 x 5 10
22 x 30	2 2 x 5 6	36 x 28	3 4 x 5 2
22 x 32	2 2 x 5 10	36 x 30	3 4 x 5 6
24 x 18	2 4 x 3 6	36 x 32	3 4 x 5 10
24 x 20	2 4 x 3 10	40 x 28	3 8 x 5 2
24 x 22	2 4 x 4 2	40 x 30	3 8 x 5 6
24 x 24	2 4 x 4 6	40 x 32	3 8 x 5 10
24 x 26	2 4 x 4 10	40 x 34	3 8 x 6 2
24 x 28	2 4 x 5 2	44 x 28	4 0 x 5 2
24 x 30	2 4 x 5 6	44 x 30	4 0 x 5 6
24 x 32	2 4 x 5 10	44 x 32	4 0 x 5 10
24 x 34	2 4 x 6 2	44 x 34	4 0 x 6 2
24 x 36	2 4 x 6 6		

TABLE XIX
French Doors
1¾″ thick

Size of Opening
4′ 0″ x 7′ 0″
5′ 0″ x 7′ 0″

TABLE XX
French or Casement Windows

Size of Opening
2′ 10″ x 5′ 2″
2′ 10″ x 5′ 6″

TABLE XXI
Sizes of Flue Linings (Outside)
2-foot lengths

Inches	Inches	Inches	Inches
4½ x 8½	7 x 7	12 x 16	16 x 16
4½ x 13	8½ x 8½	13 x 13	16 x 20
4½ x 18	8½ x 13	13 x 18	18 x 18
6 x 12	8½ x 18	14 x 16	

TABLE XXII
Flue Sizes

Number of Flues	Size of Flues	Size of Chimney
1	8½″ x 8½″	17″ x 17″
2	8½″ x 8½″	17″ x 29″
3	8½″ x 8½″	17″ x 39″
1	8½″ x 13″	17″ x 21″
2	8½″ x 8½″ & 8½″ x 13″	17″ x 33″
2	8½″ x 13″	17″ x 37″
1	8½″ x 16″	17″ x 25″
1	13″ x 13″	21″ x 21″
1	13″ x 16″	21″ x 25″

Range flues should be 8½″ x 8½″
Fireplace flues should be 13″ x 13″
Hot air furnace flues should be 8½″ x 13″ or 13″ x 13″

TABLE XXIII
Thimble Opening Sizes

For gas stoves 4″ in diameter
For ranges 6″ in diameter
For furnaces or heaters 8″ diameter

TABLE XXIV

Inside Door Sizes

Five Cross Panels. 1⅜″ Thick

Size		Size	
Width	Height	Width	Height
2′ 0″	6′ 0″	2′ 8″	6′ 8″
2′ 0″	6′ 6″	2′ 6″	7′ 0″
2′ 0″	6′ 8″	2′ 8″	7′ 0″
2′ 6″	6′ 6″	3′ 0″	7′ 0″
2′ 6″	6′ 8″		

TABLE XXV

Outside Door Sizes

1⅜″ or 1¾″ Thick

Size		Size	
Width	Height	Width	Height
2′ 6″	6′ 6″	2′ 8″	7′ 0″
2′ 8″	6′ 8″	3′ 0″	7′ 0″
2′ 10″	6′ 10″		

TABLE XXVI

Attic Sash Sizes

One Light, 3″ Bottom Rail. 1⅜″ Thick

Size of Glass	Size of Opening	Size of Glass	Size of Opening
16″ x 20″	1′ 8″ x 2′ 1″	20″ x 24″	2′ 0″ x 2′ 5″
16″ x 24″	1′ 8″ x 2′ 5″	24″ x 20″	2′ 4″ x 2′ 1″
18″ x 20″	1′ 10″ x 2′ 1″	24″ x 24″	2′ 4″ x 2′ 5″
18″ x 24″	1′ 10″ x 2′ 5″	24″ x 28″	2′ 4″ x 2′ 9″
20″ x 20″	2′ 0″ x 2′ 1″	24″ x 30″	2′ 4″ x 2′ 11″

TABLE XXVII

Two Light Cellar Sash

1⅜″ Thick

Size of Glass	Size of Opening	Size of Glass	Size of Opening
10″ x 12″	2′ 1″ x 1′ 4″	12″ x 18″	2′ 5″ x 1′ 10″
10″ x 14″	2′ 1″ x 1′ 6″	12″ x 20″	2′ 5″ x 2′ 0″
10″ x 16″	2′ 1″ x 1′ 8″	14″ x 16″	2′ 9″ x 1′ 8″
12″ x 12″	2′ 5″ x 1′ 4″	14″ x 18″	2′ 9″ x 1′ 10″
12″ x 14″	2′ 5″ x 1′ 6″	14″ x 20″	2′ 9″ x 2′ 0″
12″ x 16″	2′ 5″ x 1′ 8″		

TABLE XXVIII

Three Light Cellar Sash

1⅜″ Thick

Size of Glass	Size of Opening	Size of Glass	Size of Opening
7″ x 9″	2′ 1″ x 1′ 1″	9″ x 16″	2′ 7″ x 1′ 8″
8″ x 10″	2′ 4″ x 1′ 2″	10″ x 12″	2′ 10″ x 1′ 4″
8″ x 12″	2′ 4″ x 1′ 4″	10″ x 14″	2′ 10″ x 1′ 6″
9″ x 12″	2′ 7″ x 1′ 4″	10″ x 16″	2′ 10″ x 1′ 8″
9″ x 14″	2′ 7″ x 1′ 6″	10″ x 20″	2′ 10″ x 2′ 0″

TABLE XXIX

Transoms

One Light. 1⅜″ Thick

Size of Sash	Size of Sash
2′ 6″ x 10″	2′ 8″ x 16″
2′ 6″ x 12″	2′ 8″ x 18″
2′ 6″ x 14″	2′ 8″ x 20″
2′ 6″ x 16″	2′ 10″ x 24″
2′ 8″ x 10″	2′ 10″ x 16″
2′ 8″ x 12″	3′ 0″ x 16″
2′ 8″ x 14″	3′ 0″ x 20″

TABLE XXX

Board Measure per Lineal Foot for Different Sizes of Timber

End Size in Inches	Feet Board Measure	End Size in Inches	Feet Board Measure	End Size in Inches	Feet Board Measure
1 x 2	.17	1¼ x 10	1.04	3 x 10	2.50
1 x 3	.25	1¼ x 12	1.25	3 x 12	3.00
1 x 4	.33			3 x 14	3.50
1 x 5	.42	1½ x 2	.25		
1 x 6	.50	1½ x 3	.37	4 x 4	1.33
1 x 8	.67	1½ x 4	.50	4 x 6	2.00
1 x 10	.83	1½ x 5	.62		
1 x 12	1.00	1½ x 6	.75	6 x 6	3.00
1 x 14	1.17	1½ x 8	1.00	6 x 8	4.00
1 x 16	1.33	1½ x 10	1.25		
1 x 18	1.50	1½ x 12	1.50	8 x 8	5.33
1 x 20	1.67			8 x 10	6.66
		2 x 4	.67	8 x 12	8.00
1¼ x 2	.21	2 x 6	1.00		
1¼ x 3	.31	2 x 8	1.33	10 x 10	8.33
1¼ x 4	.42	2 x 10	1.67	10 x 12	10.00
1¼ x 5	.52	2 x 12	2.00		
1¼ x 6	.62	2 x 14	2.33	12 x 12	12.00
1¼ x 8	.83				
		3 x 4	1.00	14 x 14	16.33
		3 x 6	1.50		
		3 x 8	2.00	16 x 16	21.33

Lumber of any given width may be calculated from the table by adding together the board measure in two other sizes of the same thickness of material. For instance, a 2 x 16-inch timber will contain twice as many board feet as a 2 x 8-inch piece, or as much as a 2 x 12-inch and a 2 x 4-inch taken together.

Estimating Material for Buildings

In estimating material for buildings it is often desirable to have some easy, quick and reliable methods that will enable the contractor to arrive at a close, approximate cost without the necessity of going into all the details and making out lumber bills. As nearly all lumber is sold by board measure, it is apparent that an easy system of reducing lineal feet of different size timbers to board measure is one thing wanted. This is the case with sills, girders and beams. The lineal feet of such timbers in many plans can be determined in a few minutes; then if these quantities can quickly be reduced to board measure, the cost can be figured without difficulty. Again, if the number of feet board measure for various kinds of framing is known, then the estimate of the cost of material for such work is quickly reached. For assisting in estimating the cost of material without making out a bill in detail, the following will be of service:

TABLE XXXI

Number of Feet, Board Measure, per Lineal Foot in Sills, Girders and Beams

4″ x 6″	2 feet per lineal foot
6″ x 6″	3 feet per lineal foot
6″ x 8″	4 feet per lineal foot
8″ x 8″	5⅓ feet per lineal foot
8″ x 10″	6⅔ feet per lineal foot
10″ x 10″	8⅓ feet per lineal foot
10″ x 12″	10 feet per lineal foot
12″ x 12″	12 feet per lineal foot

TABLE XXXII

Number of Feet, Board Measure, in a Square of Framing Partitions, Including Plates

2″ x 4″ partitions set 16 inches O. C.	80 feet
2″ x 4″ partitions set 20 inches O. C.	67 feet
2″ x 4″ partitions set 24 inches O. C.	60 feet
2″ x 6″ partitions set 16 inches O. C.	120 feet
2″ x 6″ partitions set 20 inches O. C.	100 feet
2″ x 6″ partitions set 24 inches O. C.	90 feet

The framing of outside walls may be estimated the same as above.

Floors and Ceilings, Allowing One Joist in Every Square for Doubling

2″ x 4″ set 16 inches O. C.	67 feet
2″ x 6″ set 16 inches O. C.	100 feet
2″ x 8″ set 16 inches O. C.	133 feet
2″ x 10″ set 16 inches O. C.	167 feet
2″ x 12″ set 16 inches O. C.	200 feet
2″ x 12″ set 12 inches O. C.	240 feet
2″ x 14″ set 16 inches O. C.	233 feet
2″ x 14″ set 12 inches O. C.	280 feet

Roofs, Allowing One Extra Joist per Square for Cutting, etc.

2″ x 4″ set 16 inches O. C.	67 feet
2″ x 4″ set 20 inches O. C.	53 feet
2″ x 4″ set 24 inches O. C.	47 feet
2″ x 6″ set 16 inches O. C.	100 feet
2″ x 6″ set 20 inches O. C.	80 feet
2″ x 6″ set 24 inches O. C.	70 feet
2″ x 8″ set 16 inches O. C.	133 feet
2″ x 8″ set 20 inches O. C.	107 feet
2″ x 8″ set 24 inches O. C.	93 feet

TABLE XXXIII

Number of Feet, Board Measure, Required per Square, Allowing for Matching, Etc.

8 inch shiplap	116 feet
10 inch shiplap	125 feet
2¼-inch face matched flooring	133 feet
3¼-inch face matched flooring	125 feet
5¼-inch face matched flooring	120 feet
3¼-inch face matched flooring	125 feet
5¼-inch face matched flooring	120 feet
6-inch beveled siding	120 feet
4-inch beveled siding	133 feet
6-inch drop siding	120 feet
8-inch novelty siding	116 feet

TABLE XXXIV

Number of Shingles and Lath Required per Square

Shingles laid 4 inches to weather	1,000 per square
Shingles laid 4½ inches to weather	900 per square
Shingles laid 5 inches to weather	800 per square
Lath	14 lath per square yard
Per 100 yards	1,400

TABLE XXXV

Quantity of material in every four lineal feet of exterior wall in a balloon frame building, height of wall being given:

Length of Studs in Feet	Size of Sills in Inches	Size of Studs, Braces, etc. in Inches	Quantity of Rough Lumber	Quantity of Inch Boarding	Siding in Sup. Feet	Tar Paper in Sup. Feet
8	6 x 6	2x4 Studs	42	36	40	74
10	6 x 8	4x4 Braces	52	44	50	80
12	6 x 10	4x4 Plates	62	53	60	96
14	6 x 10	1x6 Ribbons	69	62	70	112
16	8 x 10		82	71	80	128
18	8 x 10	Studs	87	80	90	144
20	8 x 12	16 inches	98	88	100	160
22	9 x 12	from centers	109	97	110	176
24	10 x 12		119	106	120	192
18	10 x 10	2x6 Studs	122	80	90	144
20	10 x 12	6x6 Braces	137	88	100	160
22	10 x 12	4x6 Plates	145	97	110	176
24	12 x 12	1x6 Ribbons	162	106	120	192
26	10 x 14		169	114	130	208
28	10 x 14	Studs 16 inch	176	123	140	224
30	12 x 14	centers	198	132	150	240

TABLE XXXVI

Amounts of lumber in rafters, collar-piece and boarding, and number of shingles to four lineal feet of roof, measured from eave to eave over ridge. Rafters 16-inch centers:

Width of House, Feet	Size of Rafters in Inches	Size of Collar-piece in Inches	Quantity of Lumber in Rafter and Collar-piece	Quantity of Boarding, Feet	Number of Shingles
14	2 x 4	2 x 4	39	91	560
16	2 x 4	2 x 4	45	70	640
18	2 x 4	2 x 4	50	79	720
20	2 x 4	2 x 4	56	88	800
22	2 x 4	2 x 4	62	97	880
24	2 x 4	2 x 4	67	106	960
20	2 x 6	2 x 6	84	88	800
22	2 x 6	2 x 6	92	97	880
24	2 x 6	2 x 6	101	106	960
26	2 x 6	2 x 6	109	115	1,040
28	2 x 6	2 x 6	117	124	1,120
30	2 x 6	2 x 6	126	133	1,200

TABLE XXXVII

Labor Quantities in Carpentry Work

A good workman will average the following amounts of work on ordinary buildings in an 8-hour day:

Set about 500 board feet of joists, studs or common rafters.
Put on about 400 feet of dressed and matched or shiplap sheathing.
Put on about 500 feet of common sheathing on roofs or floors.
Put on about 350 feet of common 6-inch siding.
Lay about 350 feet of 4 to 6-inch flooring.
Cut and lay 1,500 shingles.
Cut and lay 250 feet of clapboards.
Fit and hang 10 two-sash windows.
Put on about 1,000 feet of rough barn boards.
Set and fit about 8 window frames.
Fit and hang 8 ordinary doors.
Case about 5 ordinary doors, one side only.

TABLE XXXVIII

Weight of Wire Nails Needed per 1,000 Feet of Lumber

Size of Material in Inches	Distance Apart of Joist or Studding Nailing Space in Inches	Number of Nails to Each Board, Each Nailing Space	Size of Nail	Pounds of Nails	Size of Nail	Pounds of Nails
1 x 4	12	2	8d com.	57	10d com.	84
1 x 4	16	2	8d com.	43	10d com.	65
1 x 4	24	2	8d com.	30	10d com.	45
1 x 6	12	2	8d com.	38	10d com.	56
1 x 6	16	2	8d com.	29	10d com.	43
1 x 6	24	2	8d com.	20	10d com.	30
1 x 8	12	2	8d com.	28	10d com.	42
1 x 8	16	2	8d com.	22	10d com.	32
1 x 8	24	2	8d com.	15	10d com.	23
1 x 10	12	2	8d com.	23	10d com.	34
1 x 10	16	2	8d com.	17	10d com.	26
1 x 10	12	3	8d com.	34	10d com.	51
1 x 10	16	3	8d com.	26	10d com.	39
1 x 10	24	3	8d com.	18	10d com.	27
1 x 12	16	3	8d com.	22	10d com.	32
1 x 12	24	3	8d com.	15	10d com.	23
2 x 6	16	2	20d com.	54	30d com.	75
2 x 6	24	2	20d com.	37	30d com.	53
2 x 8	24	2	20d com.	28	30d com.	40
2 x 10	24	3	20d com.	34	30d com.	48
2 x 12	24	3	20d com.	28	30d com.	40
3 x 6	24	2	40d com.	45	60d com.	70
3 x 8	24	2	40d com.	34	60d com.	52
3 x 10	24	3	40d com.	41	60d com.	63
3 x 12	24	3	40d com.	35	60d com.	54
Shiplap						
1 x 8	12	2	8d com.	32	10d com.	47
1 x 8	16	2	8d com.	25	10d com.	36
1 x 8	24	2	8d com.	17	10d com.	26
1 x 10	12	2	8d com.	25	10d com.	37
1 x 10	16	2	8d com.	19	10d com.	29
1 x 10	24	2	8d com.	13	10d com.	20
1 x 10	12	3	8d com.	37	10d com.	56
1 x 10	16	3	8d com.	29	10d com.	43

TABLE XXXVIII—Cont.

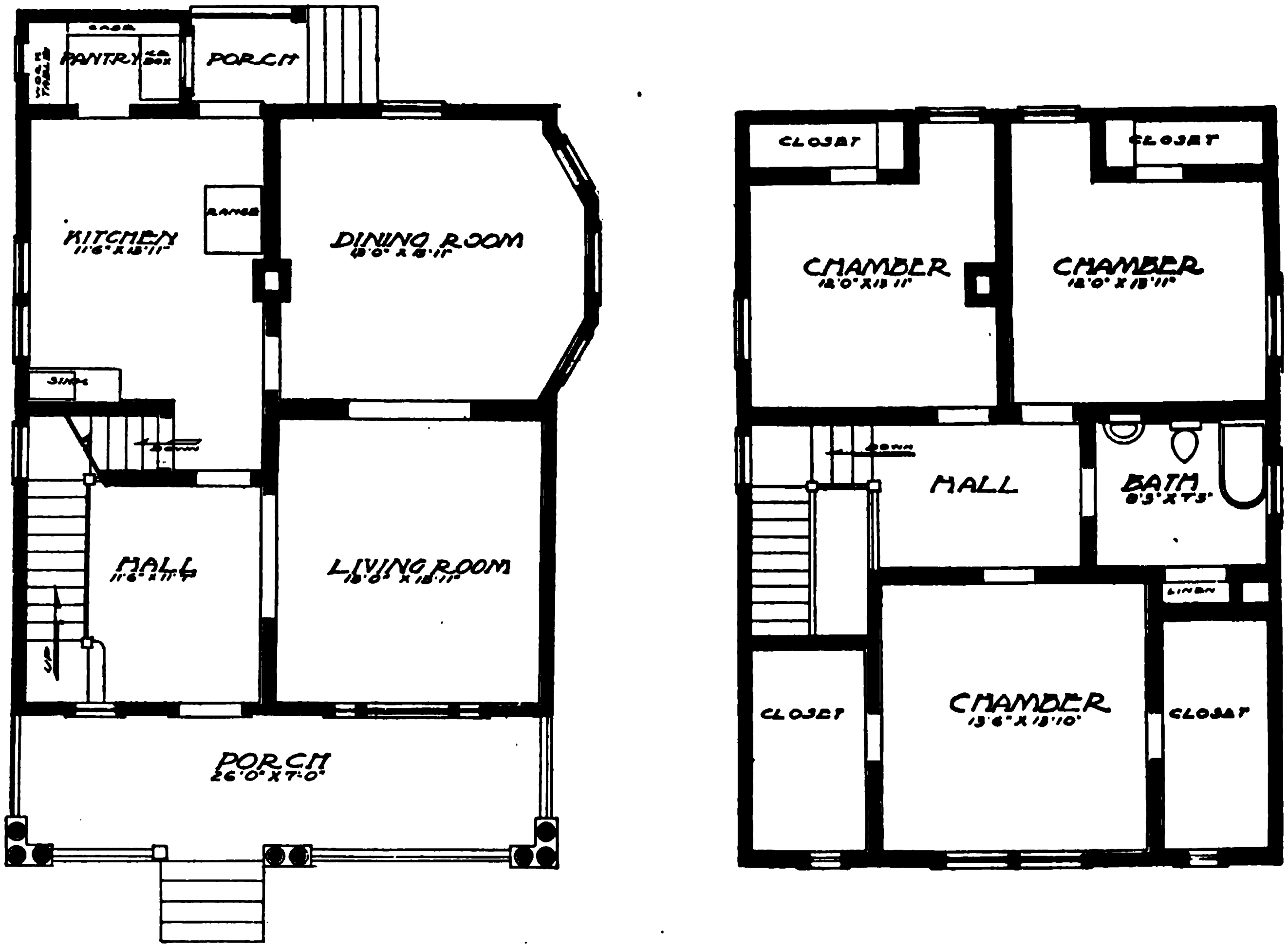
Weight of Wire Nails Needed per 1,000 Feet of Lumber

Size of Material in Inches	Distance Apart of Joist or Studding Nailing Space in Inches	Number of Nails to Each Board, Each Nailing Space	Size of Nail	Pounds of Nails	Size of Nail	Pounds of Nails
1 x 10	24	3	8d com.	20	10d com.	30
1 x 12	12	3	8d com.	30	10d com.	45
1 x 12	16	3	8d com.	24	10d com.	35
1 x 12	24	3	8d com.	16	10d com.	25
Flooring						
⅜ x 2½	12	1	4d fin.	9	5d fin.	13
1 x 3	12	1	6d flg.	16	8d flg.	27
1 x 3	16	1	6d flg.	12	8d flg.	21
1 x 3	12	1	6d com.	28	8d com.	50
1 x 3	16	1	6d com.	21	8d com.	39
1 x 4	12	1	6d flg.	11	8d flg.	19
1 x 4	16	1	6d flg.	9	8d flg.	15
1 x 4	12	1	6d com.	19	8d com.	35
1 x 4	16	1	6d com.	15	8d com.	27
1 x 6	12	1	6d com.	12	8d com.	23
1 x 6	16	1	6d com.	10	8d com.	18
1 x 6	24	1	6d com.	7	8d com.	12
1 x 6	12	2	6d com.	24	8d com.	46
1 x 6	16	2	6d com.	20	8d com.	36
1 x 6	24	2	6d com.	14	8d com.	24
1 x 8	12	2	8d com.	32	10d com.	47
1 x 8	16	2	8d com.	25	10d com.	36
1 x 8	24	2	8d com.	17	10d com.	26
Ceiling						
⅜ x 4	24	1	5d fin.	4	6d fin.	6
⅜ x 6	24	1	5d fin.	3	6d fin.	4
⅝ x 4	24	1	6d fin.	6	8d fin.	10
⅝ x 6	24	1	6d fin.	4	8d fin.	6
⅞ x 6	24	1	6d com.	7	8d com.	12
Siding						
½ x 4	16	1	6d com.	15	8d fin.	15
½ x 6	16	1	6d com.	10	8d fin.	10
½ x 4	16	1	6d fin.	9	7d fin.	10
½ x 6	16	1	6d fin.	6	7d fin.	7

CHAPTER XVIII
SUGGESTIVE DESIGNS

FIGURE 65.

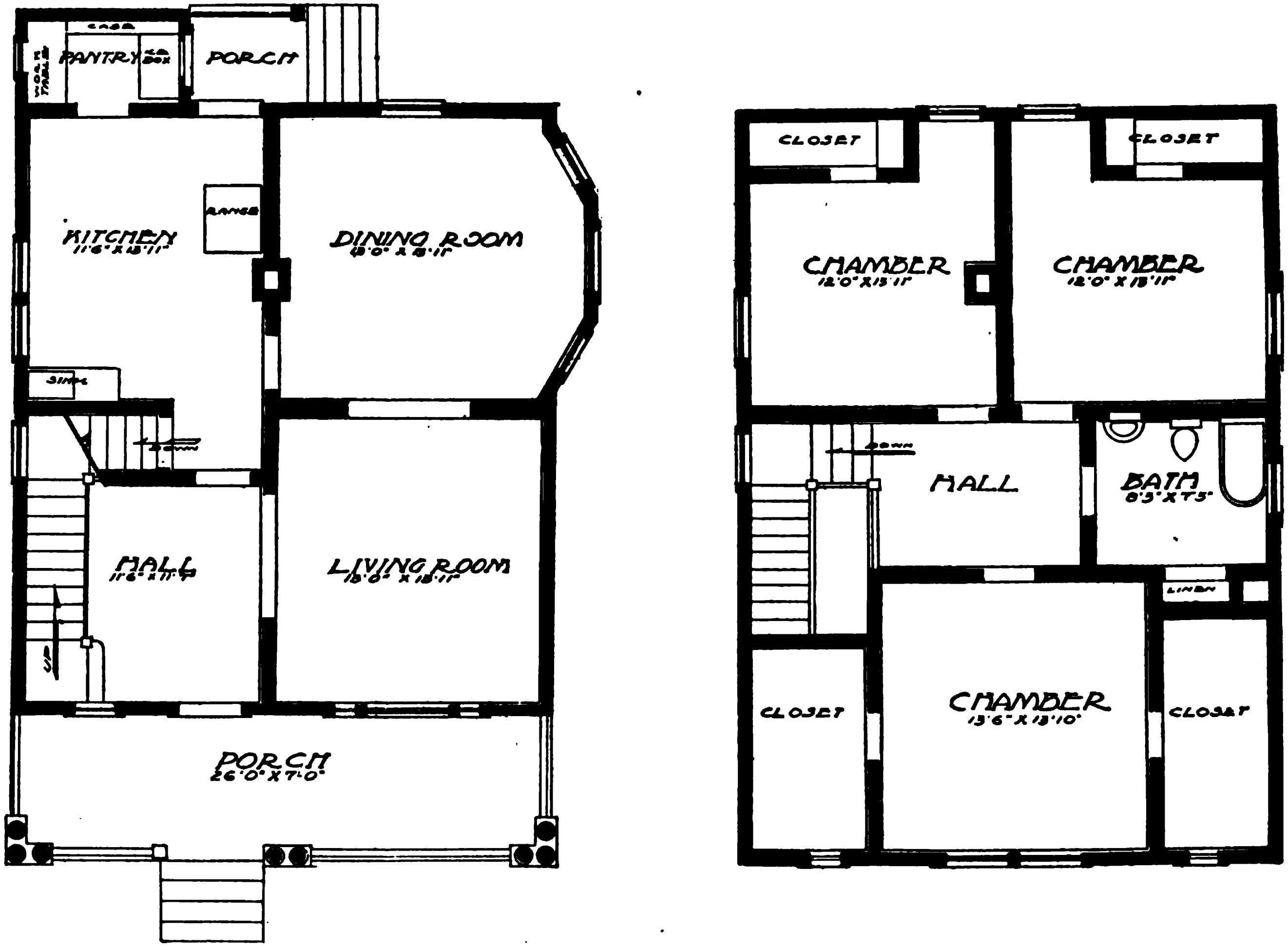
FIGURE 66.



FIRST FLOOR PLAN SECOND FLOOR PLAN

FIGURE 67.

FIGURE 66.

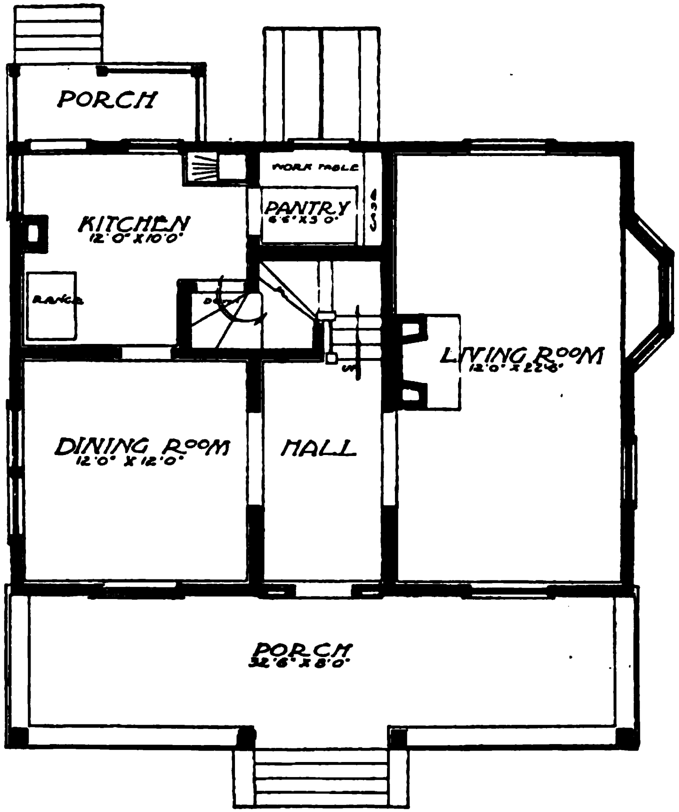


FIRST FLOOR PLAN

SECOND FLOOR PLAN

FIGURE 67.

FIGURE 68.



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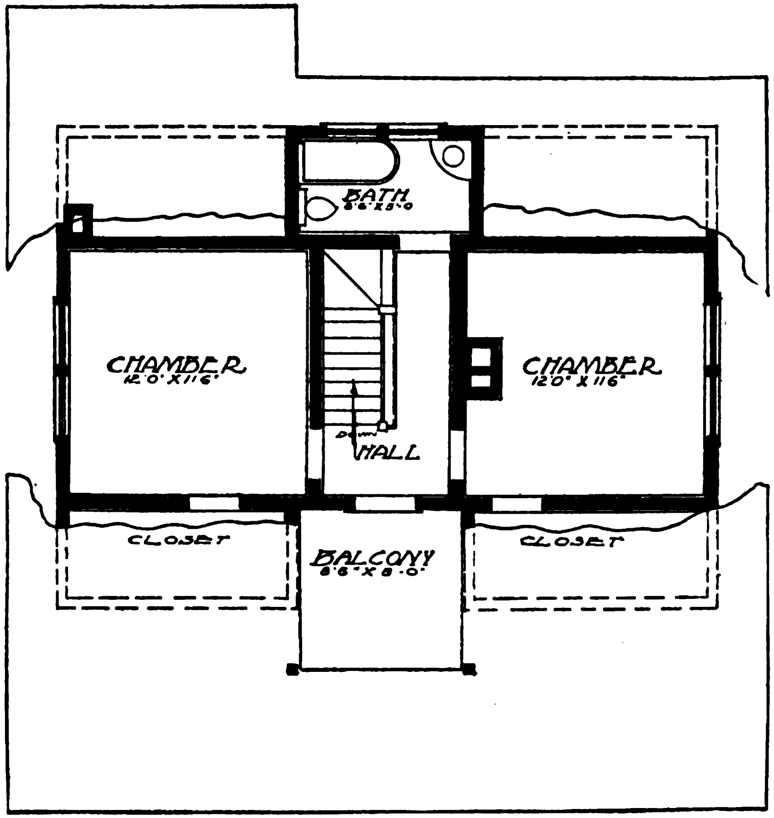
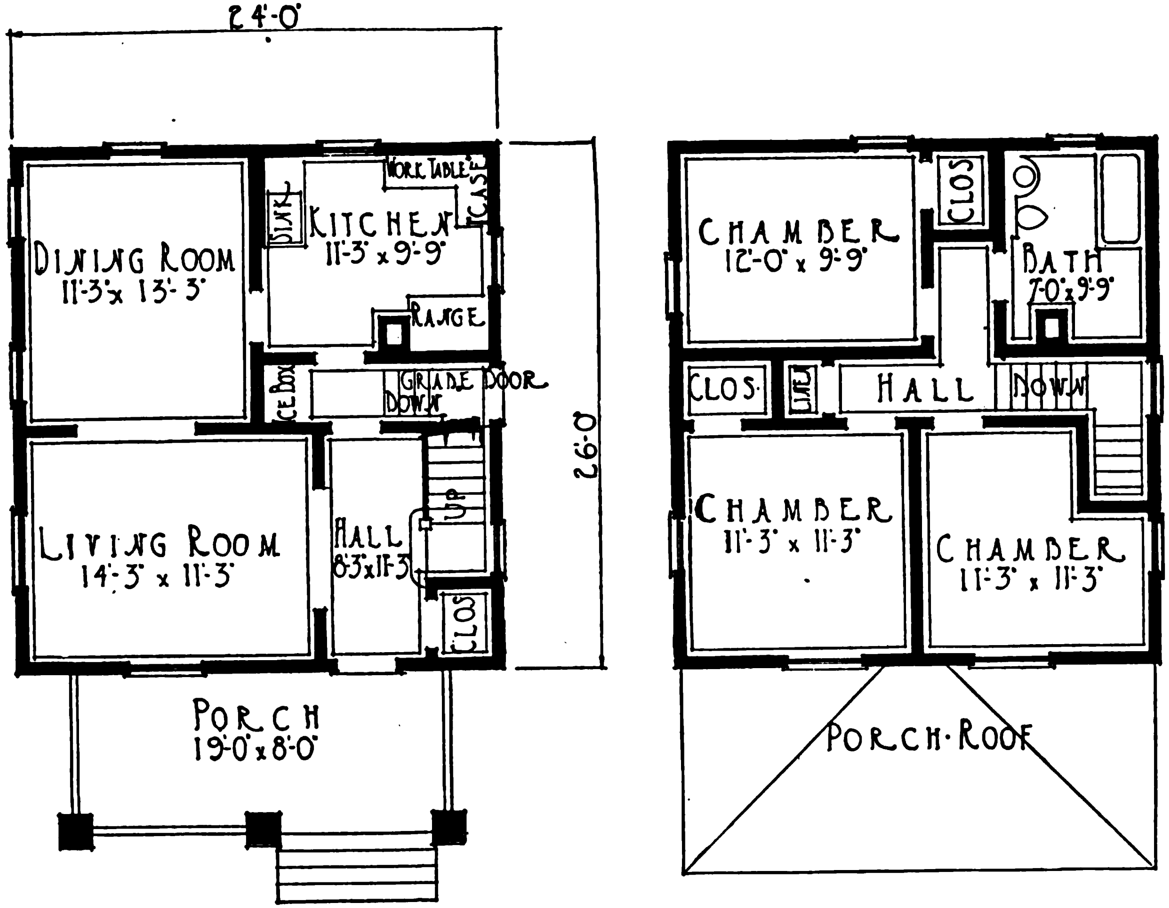


SECOND FLOOR PLAN

FIGURE 69.

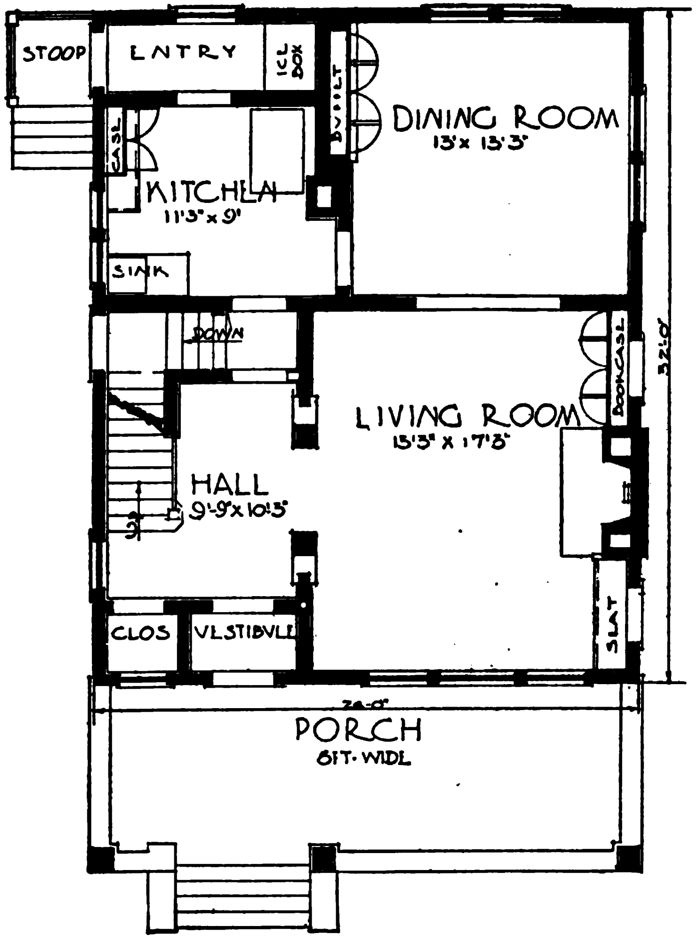
FIGURE 70.



FIRST FLOOR PLAN SECOND FLOOR PLAN

FIGURE 71.

FIGURE 72.



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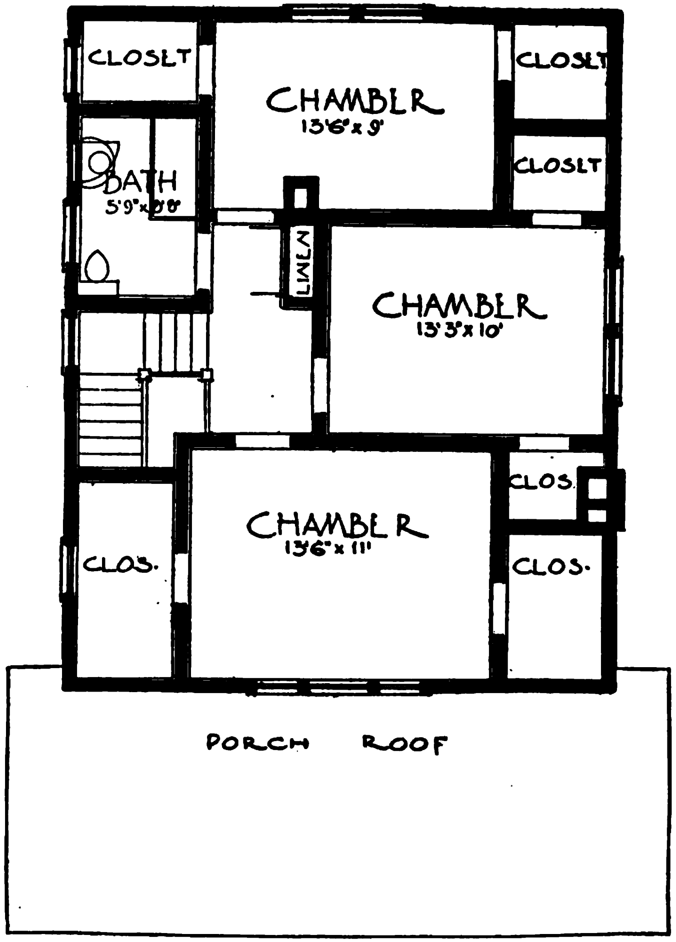
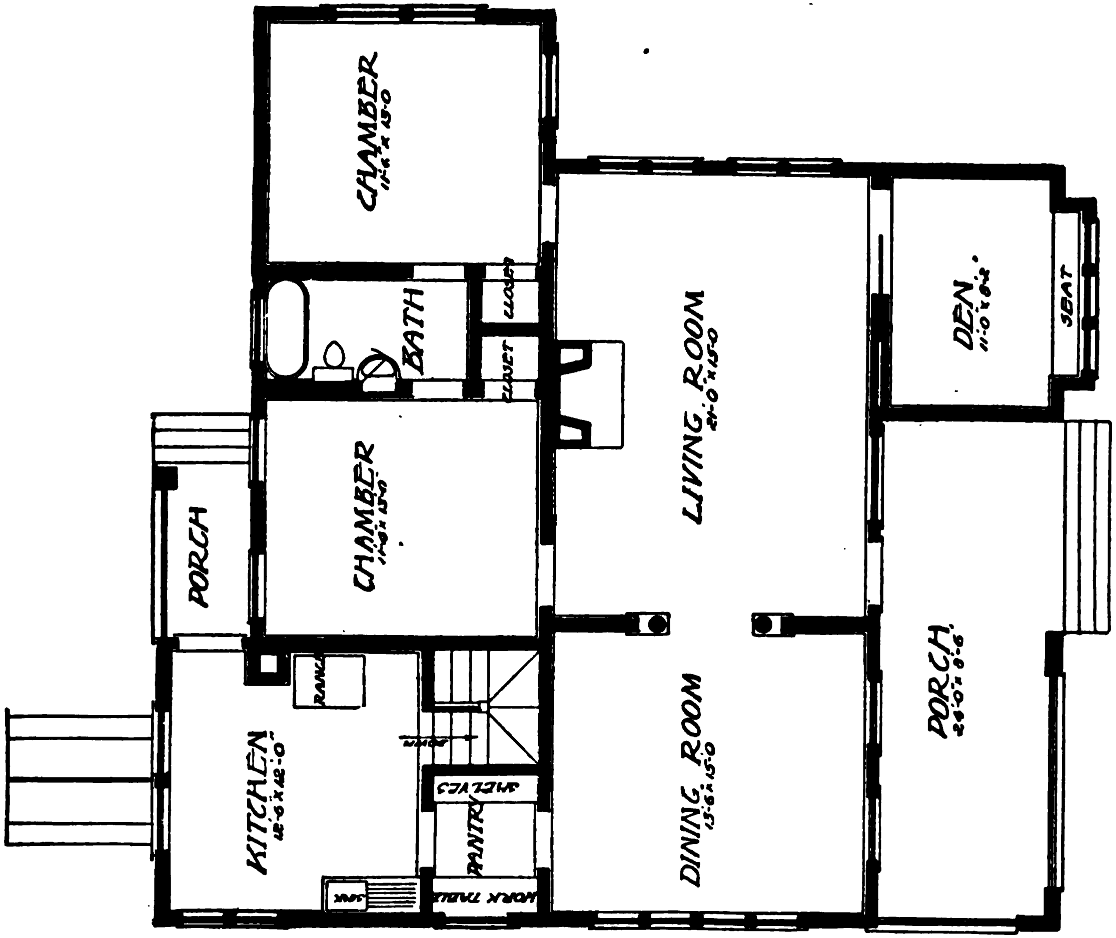


SECOND FLOOR PLAN

FIGURE 73.

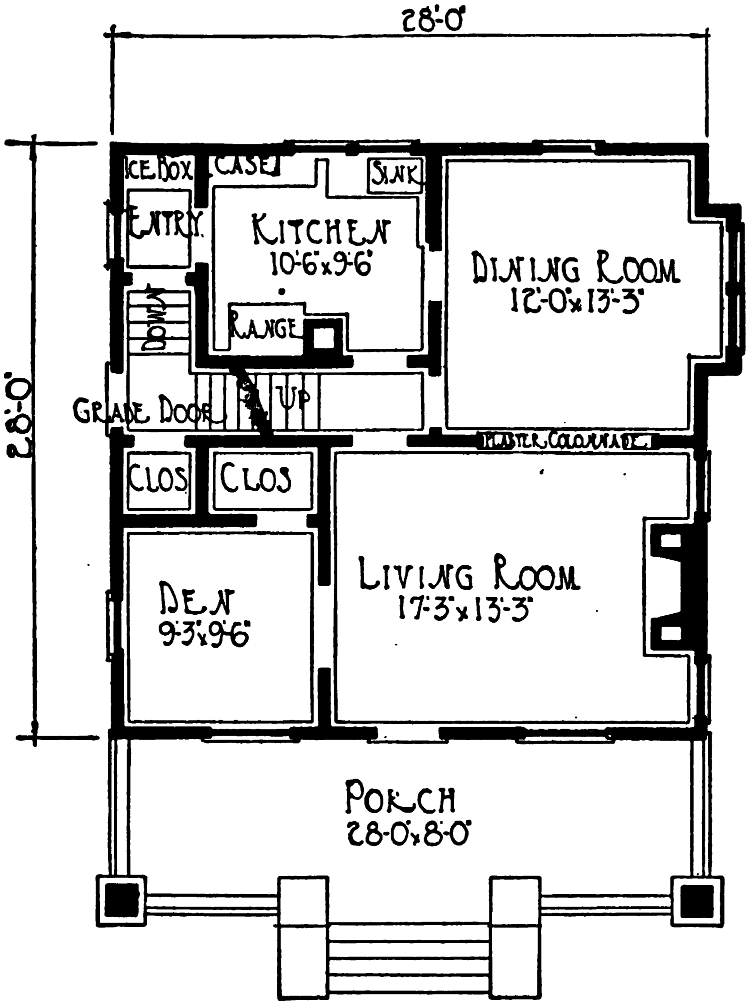
FIGURE 74.



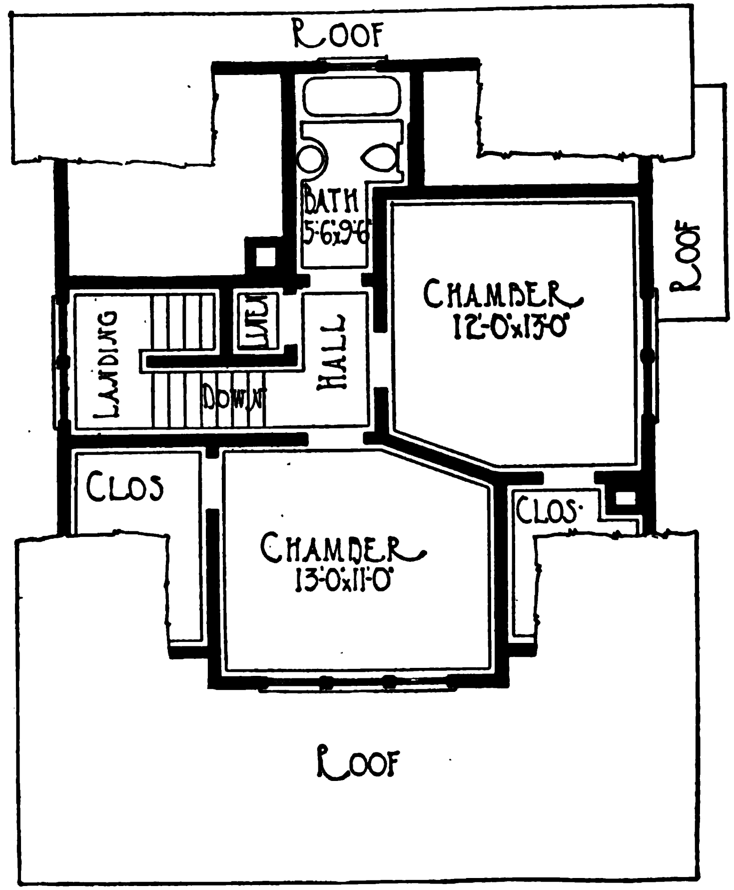
FLOOR PLAN

FIGURE 75.

FIGURE 76.



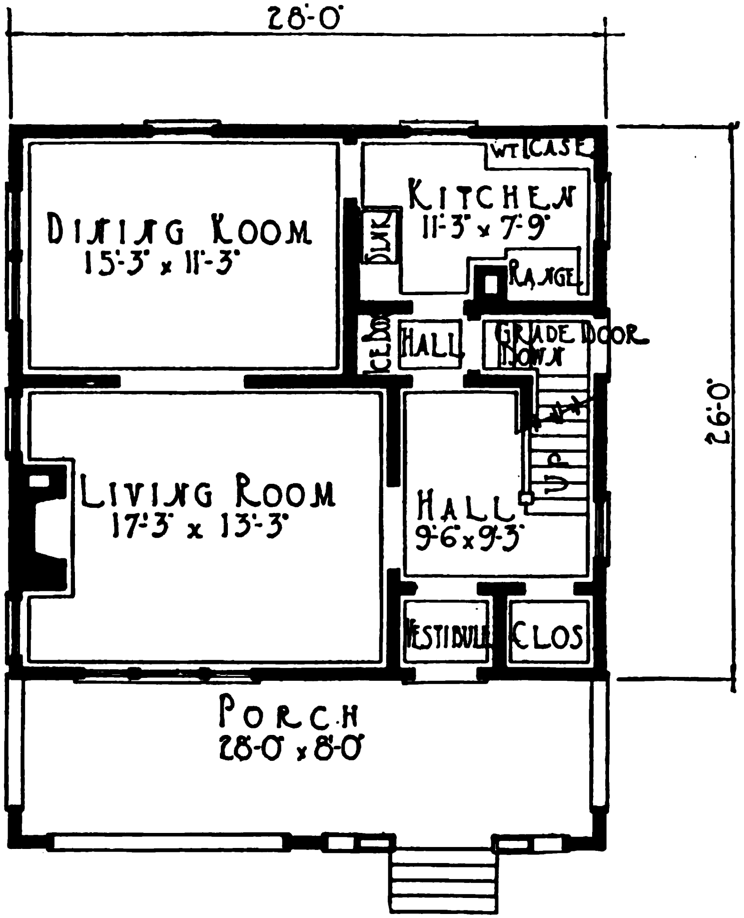
FIRST FLOOR PLAN



SECOND FLOOR PLAN

FIGURE 77.

FIGURE 78.



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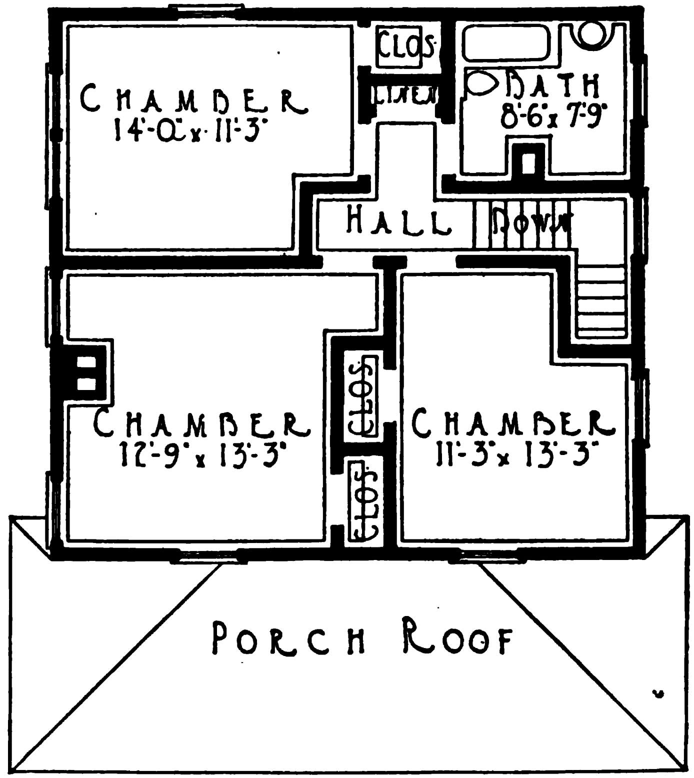
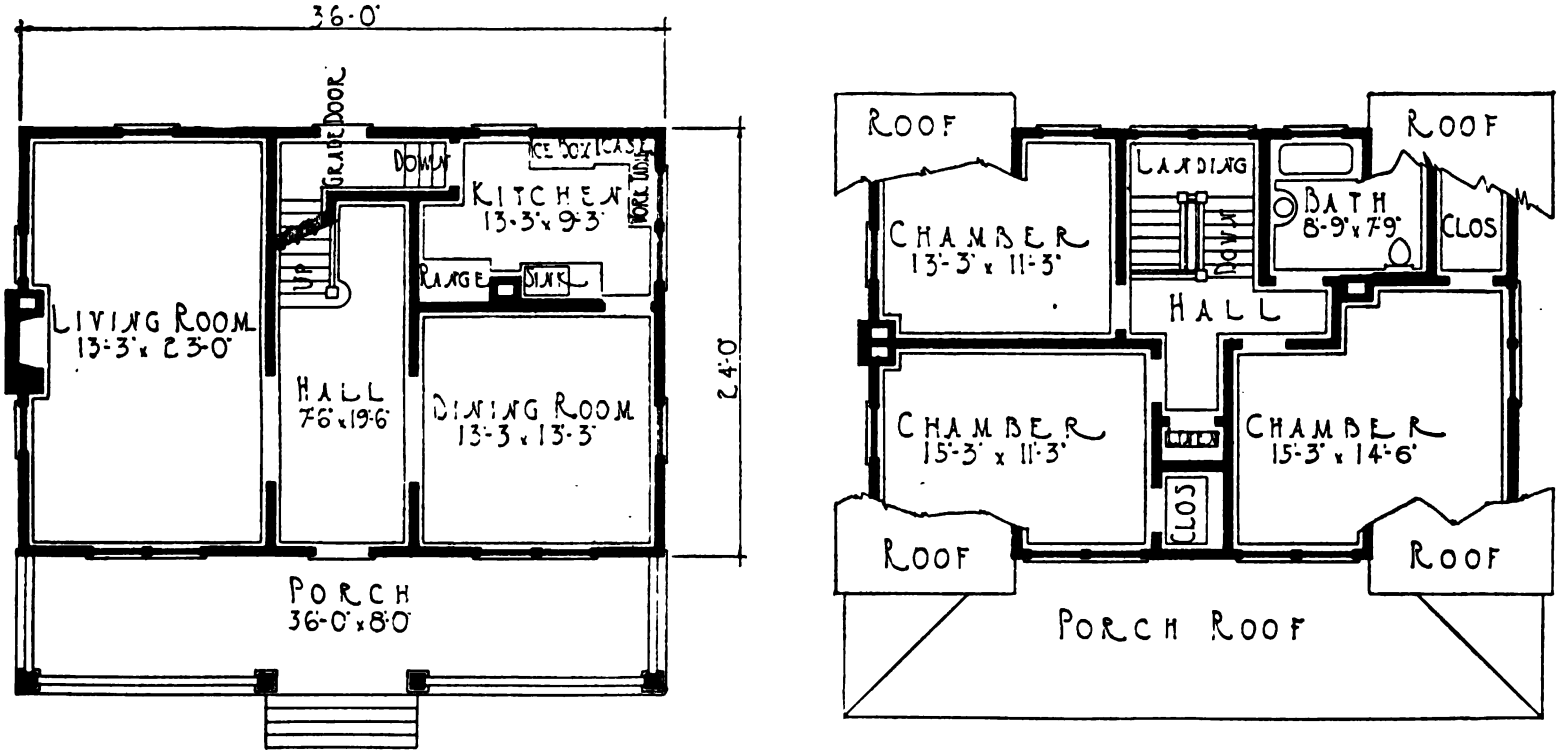


SECOND FLOOR PLAN

FIGURE 79.

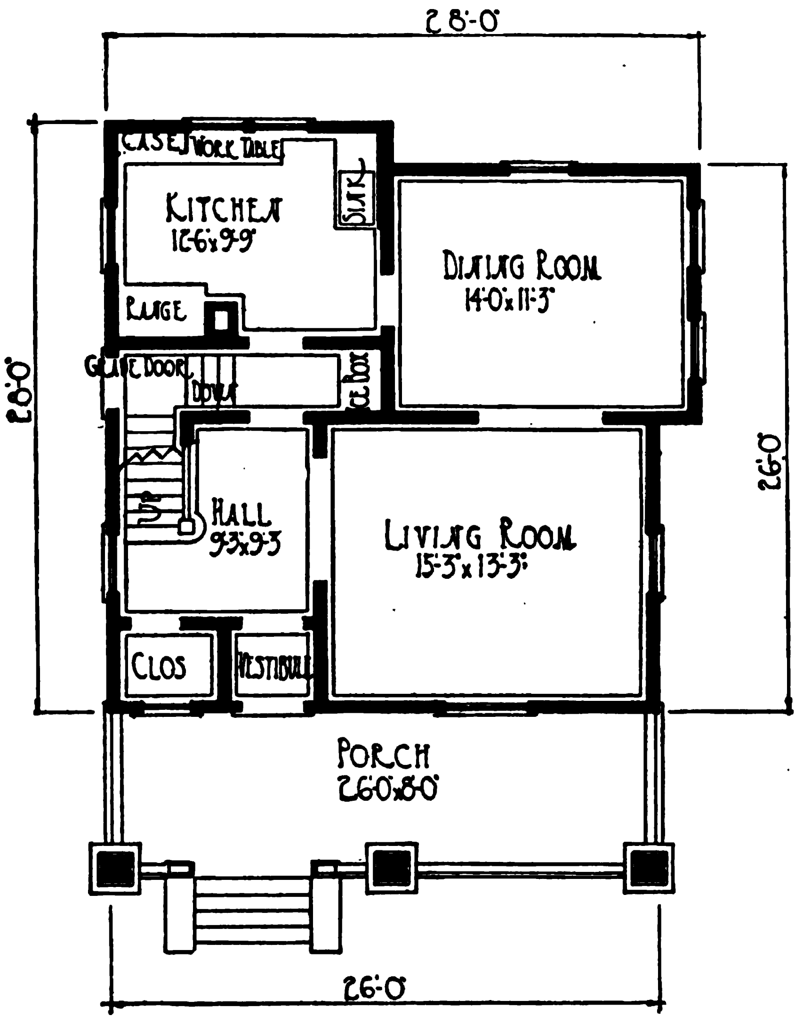
FIGURE 80.



FIRST FLOOR PLAN SECOND FLOOR PLAN

Figure 81.

FIGURE 82.



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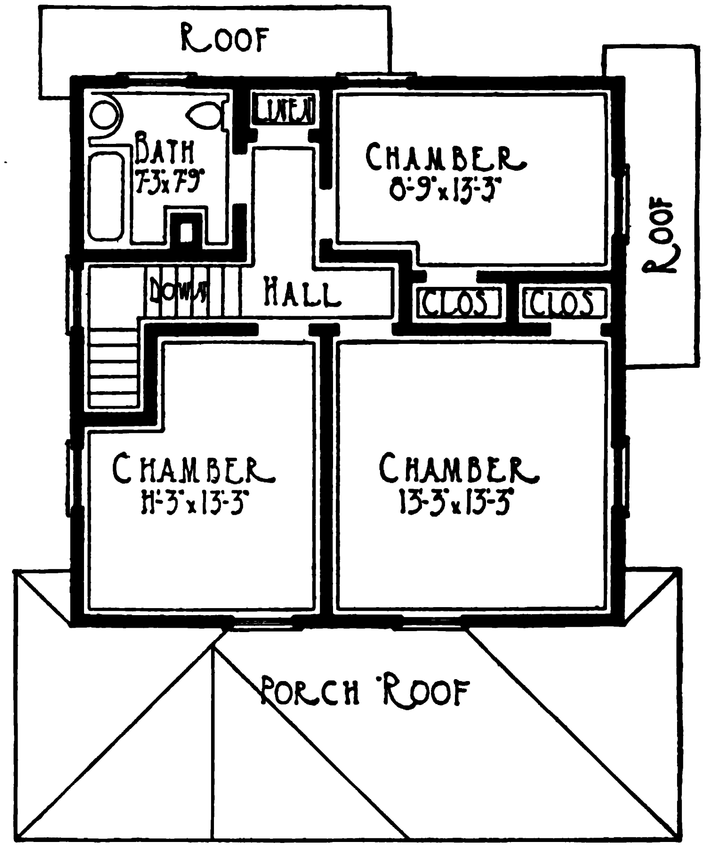
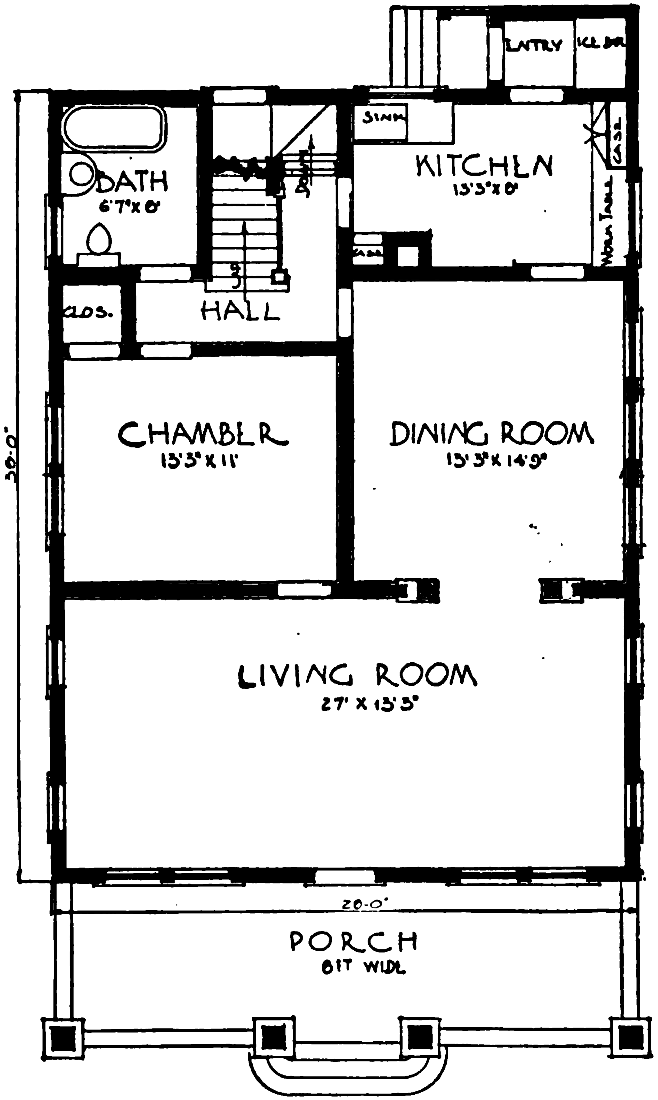


SECOND FLOOR PLAN

FIGURE 83.

FIGURE 84.



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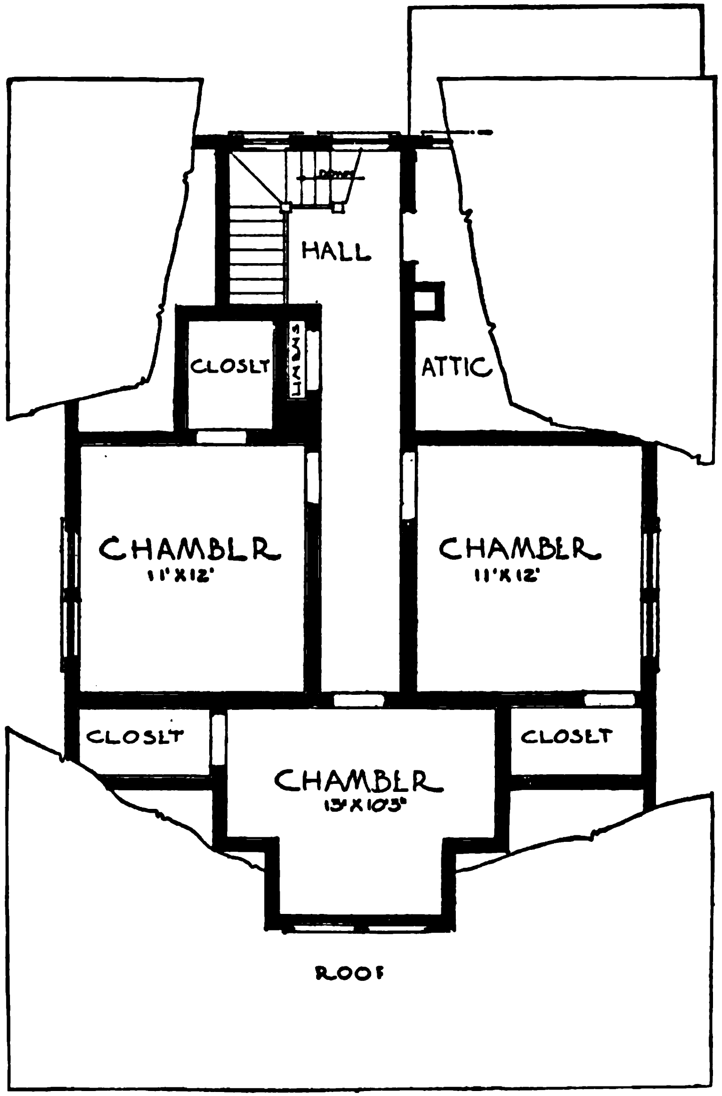
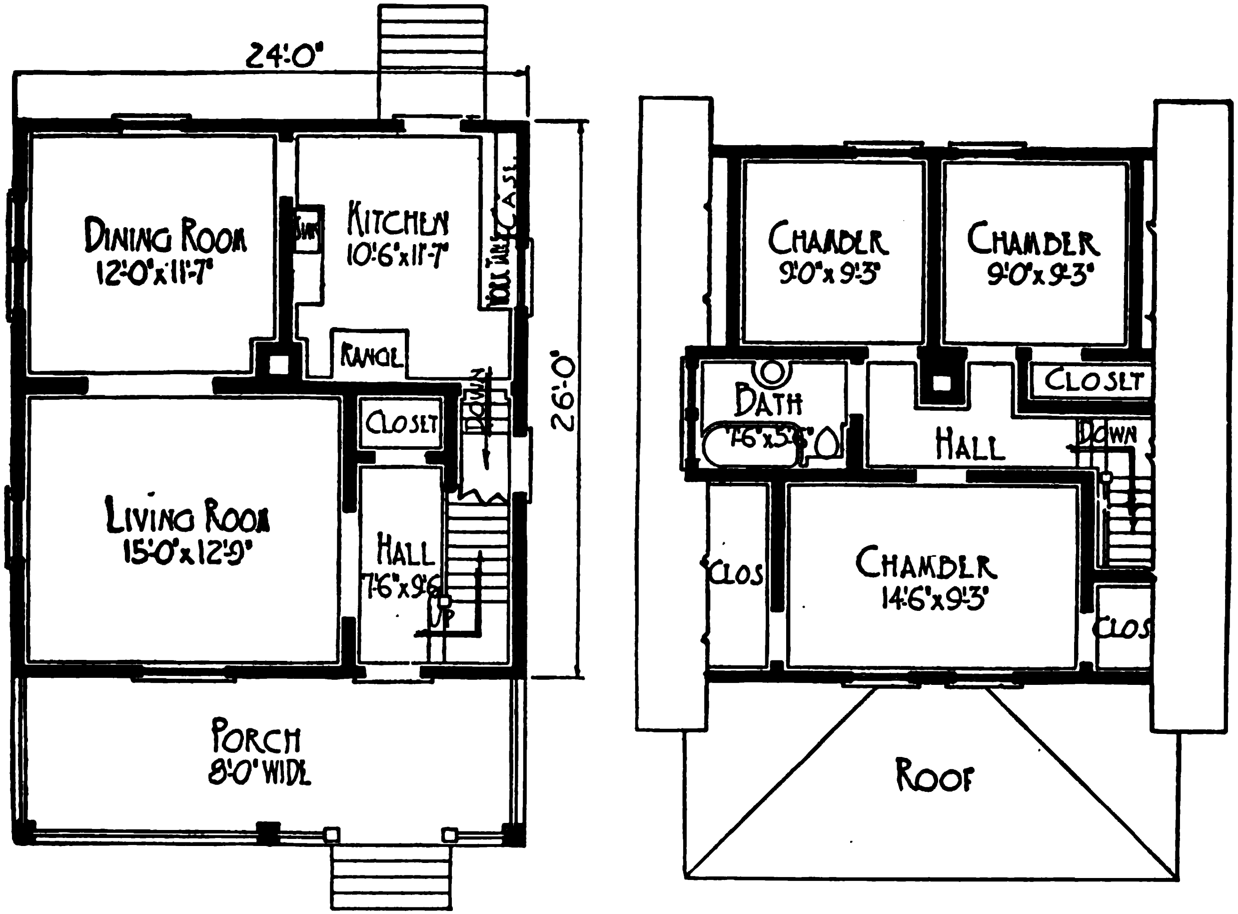


SECOND FLOOR PLAN

FIGURE 85.

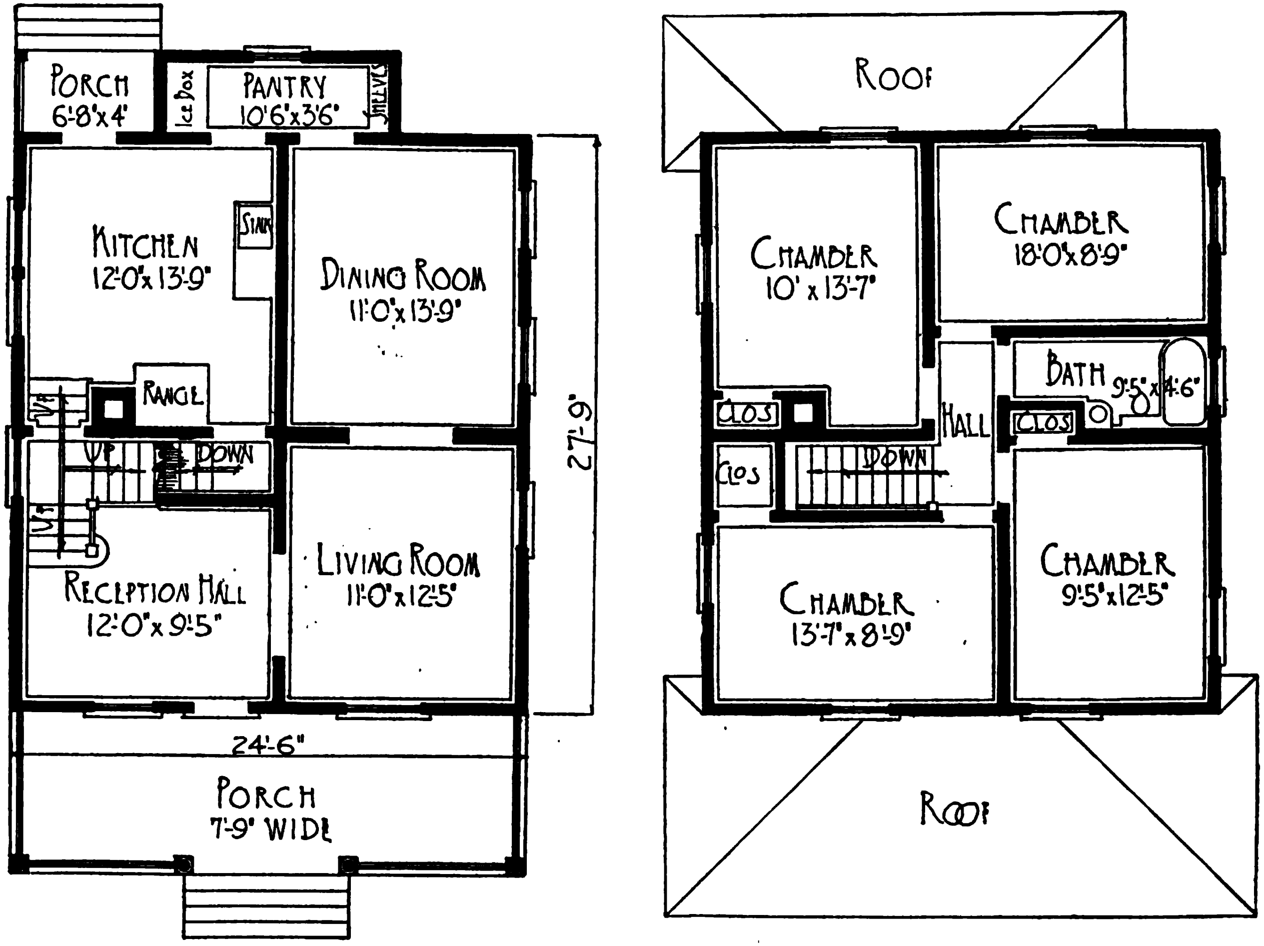
FIGURE 86.



FIRST FLOOR PLAN SECOND FLOOR PLAN

FIGURE 87.

FIGURE 88.



FIRST FLOOR PLAN SECOND FLOOR PLAN

FIGURE 89.

DATE DUE

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